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# Assessment of consumers' knowledge, attitude and perception of the impact of the COVID-19 pandemic on household food security in Caribbean Small Island Developing States

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**Introduction:** The COVID-19 pandemic and recent international crises including the Russia-Ukraine conflict have resulted in significant disruptions along multiple segments of the Caribbean's agri-food system, thus compromising regional food security. These impacts are still ongoing with the potential to worsen. The aim of this study was to investigate the influence of sociodemographic factors on consumers' knowledge of food security along with their attitude, and perception towards the impact of the COVID-19 pandemic on household food security in the Caribbean Small Island Developing States.

**Method:** A cross-sectional on-line survey was conducted between January 1 and November 30, 2021. The sampled population included consumers from nine Caribbean countries (Trinidad and Tobago, Barbados, Jamaica, Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines). Survey data were analyzed using Chi-square, one way analysis of variance, and univariate logistic regression.

**Results and discussion:** A total of 237 consumers participated in the survey. Consumers were generally knowledgeable about food security and had favorable attitudes and perceptions of the impact of the COVID-19 pandemic on household food security. Significant associations ( $p < 0.05$ ) and significant differences ( $p < 0.05$ ) were obtained for consumers' knowledge, attitude and perception among the sociodemographic variables assessed. The results suggest that there were different levels of vulnerability to food insecurity associated with the COVID-19 pandemic, particularly among economically vulnerable households. Policies that support disadvantaged households and ensure adequate employment opportunities are important to support Caribbean consumers throughout and post the COVID-19 pandemic recovery.

## KEYWORDS

Caribbean, consumer, COVID-19, household food security, sociodemographic factors

## Introduction

The definition of food security agreed upon at the World Food Summit held in 1996 is that food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life (Pinstrup-Andersen, 2009). Four dimensions have been identified and understood as necessary conditions for food security to exist namely: (1) availability (is the supply of food adequate?); (2) access (can people obtain the food they need?); (3) utilization (do people have enough intake of nutrients?); and (4) stability (can people always access food?) (Pinstrup-Andersen, 2009; Saint Ville et al., 2019). The COVID-19 pandemic and the compounding effects of other international crises affected all four pillars of food security. Firstly, loss of income as a result of COVID-19 affected people's ability to purchase food especially in developing regions where almost 70% of earnings are spent on food (Laborde et al., 2020). Additionally, availability and stability were also areas of concern since production and distribution of food were affected globally (CARICOM et al., 2020; Luo et al., 2020; Meuwissen et al., 2021). The issues of food security during the COVID-19 pandemic were of greater concern in developing countries such as Caribbean Island Developing States (CSIDs) due to their heavy reliance on manual labor in agricultural production and restriction to movements imposed by most governments which affected local production of and distribution of foods (Laborde et al., 2020). Kent and Haralambides (2022) reported that supply chain crisis was further compounded by the lack of labor, truck drivers, and even warehousing. Considering the vulnerability of food systems in CSIDs to natural hazards and geopolitical conflicts, an understanding of consumer actions and sociodemographic factors that influence behavior can inform approaches to address food security concerns.

Globalization has resulted in significant interconnectivity and interdependence of various countries, regions, and sectors. This is particularly true for the agricultural sector of Caribbean Small Island Developing States (CSIDs), where importation of inputs is significant with some countries importing over 80% of their food (Mohammadi et al., 2022; Rahman, 2022). Ultimately, this level of external dependence renders CSIDs extremely vulnerable to global shocks. For import dependent countries like CSIDs, international crises especially those associated with major trading partners can have deep repercussions on the economies and people's livelihoods are undoubtedly affected. These scenarios unraveled years of achievements under the sustainable development goals (SDGs) by weakening food systems and undermining regional food security (Bignell, 2022). Globally, the COVID-19 pandemic and the Russia-Ukraine conflict has crippled the global supply of grains and a 40 million metric tonne deficit was projected for 2023 (Glauber, 2023; Janzen and Zulauf, 2023). These concerns were further compounded by a decline in fertilizer supply, particularly from Russia and Belarus, which will negatively impact food production (Behnassi and El Haiba, 2022). Higher energy costs are also expected to exert upward pressure on food prices, potentially pushing millions into acute food insecurity (Behnassi and El Haiba, 2022).

The COVID-19 pandemic also led to a worsening of inequality and the food insecurity gender gap, respectively, with food insecurity among women being 10% higher than among men in 2020 (FAO et al., 2022). According to the 2021 State of Food

Security and Nutrition (SOFI), the effect of COVID-19 on food security is palpable and detrimental. For example, in Latin America and the Caribbean region the prevalence of undernourishment increased by 2% or 13.8 million people between 2019 and 2020, which was directly and indirectly influenced by the COVID-19 pandemic (FAO et al., 2021). Given the existing challenges before the pandemic, achieving the UN 2030 Agenda of eliminating hunger is poised to become more complicated, threatening millions of people's food security and nutrition worldwide (FAO, 2021). Among the poorest households, where almost 70% of revenue is spent on food, the pandemic has either directly or indirectly compromised their food security. According to WFP et al. (2021), an estimated 2.8 million people or nearly 40% of the population in the English-speaking Caribbean is food insecure, reflecting a 72% increase when compared to April 2020. The combined effect of the COVID-19 pandemic and the escalation in the Russia-Ukraine conflict along with increasing energy prices, poses a serious concern for developing nations as it relates to food security, particularly CSIDs due to their high level of food imports. Agricultural production decreased, supply chains were compromised, and the cost of key agricultural inputs increased (Behnassi and El Haiba, 2022).

Climate Change and the consequent increase in frequency and intensity of natural hazards is yet another factor impacting global and regional food security. Increasing global temperature is expected to expose the world to further climate hazards and food insecurity, leading to higher poverty levels, especially in vulnerable regions (Pörtner et al., 2022). Among low-income countries, the threat is even greater for those that are susceptible to higher temperatures and lack of fresh water (Kogo et al., 2021). CSIDs are considered to be one of the most vulnerable regions in the world to climate change and variability due to their geographical location and inherent geophysical features. They are particularly vulnerable to hydro-climatic hazards, where floods and drought directly impact quality and quantity of agricultural produce (Roopnarine et al., 2021).

Considering the vulnerability of food systems in CSIDs to natural hazards, pandemics and geopolitical conflicts, an understanding of consumer behavior and sociodemographic factors that influence behavior can inform approaches to address food security concerns. Similar studies have been done in other regions but not among CSIDs. Therefore, this study aimed to investigate the influence of sociodemographic factors on knowledge of food security and attitude and perception in relation to the impact of COVID-19 pandemic on household food security. Noting the uniqueness and inherent vulnerability of food systems in CSIDs, an understanding of consumer behavior, factors influencing their choices, attitudes and their perception of impacts will play a crucial role in developing policies and strategies to improve regional food security.

## Methods

### Study design and participants

A cross-sectional on-line survey was conducted between January 1 and November 30, 2021, to investigate consumers' knowledge of food security along with their attitudes and perception of food security based on the impact of the COVID-19 pandemic in CSIDs. The

sampled population included consumers from nine Caribbean countries (Trinidad and Tobago, Barbados, Jamaica, Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines). However, for analysis purposes, Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines were treated as one block referred to as the Eastern Caribbean (EC).

## Data collection

The survey link was distributed online using various crowdsourcing approaches including direct emails and social media. Convenience sampling and snowball sampling methods were also used where participants were asked to complete the questionnaire and share with their contacts to recruit a large majority of the population, and ensure wide distribution of the survey link. The questionnaire was completed anonymously and with prior online informed consent by consumers. The participants were given no reward or incentive.

## Measures

Nine socio-demographic variables were collected, including sex, age category; highest education level attained; country of residence, rurality, household size (number of members living in the household), monthly household income (in United States dollars), employment status and breadwinner status. Additional questions asked respondents to indicate their knowledge of food security by responding “yes” or “no” to a series of statements about the various dimensions of food security (Table 1). Similarly, respondents were asked to give responses to statements geared toward depicting their attitude and perception toward household food security based on the impact of the COVID-19 pandemic (Table 2). These responses were based on a five-point Likert scale (1 - strongly disagree, 2 - disagree, 3 - neutral, 4 - agree, and 5 - strongly agree; Table 2).

## Coding and data analysis

Data obtained from the online surveys were numerically coded and then subjected to both descriptive and inferential statistical analysis. Overall knowledge, attitude and perception scores for consumers were determined by using total scores obtained by summing the scores of all statements within respective sections. For the section on knowledge, responses to statements ( $n=10$ ) were scored as follows: Yes = 2 and no = 1, and the scores were combined to give a score range of 10–20. For the section on attitude, responses to statements ( $n=8$ ) were scored as follows: Strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5 and the scores were combined to give a score range of 8–40. For the section on perception, responses to statements ( $n=10$ ) were scored as follows: Strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5 and the scores were combined to give a score range of 10–50.

Next, overall scores in each section were tallied for descriptive purposes and to operationalize each variable. For knowledge, low knowledge ranged from 10–13, fair knowledge ranged from 14–17,

TABLE 1 Consumer knowledge of food security during the COVID-19 pandemic.

Statements	Yes (%)	No (%)
I know that having the ability to purchase food is an aspect of food security	81.2	18.8
I know that having the necessary transport and market infrastructure in place is part of food security	72.9	27.1
I know that domestic production of food is an aspect of food security	85.3	14.7
I know that having the ability to import food contributes to food security	74.6	25.4
I know that providing food aid contributes to food security	72.4	27.6
I know that securing food stocks is part of food security	93.5	6.5
I know that having access to safe food is part of food security	94.7	5.3
I know that changes in weather affect food security	92.9	7.1
I know that political factors which affect the stability of a country affect food security	90.5	9.5
I know that factors that contribute to price fluctuations affect food security	90.0	10.0
Knowledge mean	84.8	15.2

and high knowledge ranged from 18–20. Knowledge, represents the respondent's awareness of the different dimensions of food security. For attitude level, very unfavorable attitude ranged from 8–16, unfavorable attitude ranged from 17–24, favorable attitude ranged from 24–32, and highly favorable attitude ranged from 33–40. The assessment of attitude captures respondents feeling toward the four dimensions of food security during the COVID-19 pandemic. With respect to perception, statements were reversed (negatively stated) so that agreement with a negative statement showed unfavorable perceptions toward food security. Accordingly, very favorable perception ranged from 10–20, favorable perception ranged from 21–30, unfavorable perception ranged from 31–40 and very unfavorable perception ranged from 41–50. The perception questions sought to capture respondents' thoughts about food security by encouraging logical thinking based on their experience.

Chi-square tests of association were performed using the ordinal values for knowledge (low, fair, and high), attitude and perception (highly favorable, favorable, unfavorable, and very unfavorable) to examine associations between knowledge, attitude, and perception with the socio-demographic factors. One-way analysis of variance (ANOVA) tests and the associated *post-hoc* test (Tukey's b) were performed using the total tallied score for each respondent to examine significant differences among mean score of knowledge attitude, and perception with the socio-demographic factors as independent variables. Spearman's rank order correlation coefficients were calculated to examine the interrelationships among the socio-demographic factors to select factors for further analysis. Univariate ordinal logistic regression analyses using the ordinal values for knowledge (low, fair, and high), attitude and perception (highly favorable, favorable, unfavorable, and very unfavorable) were performed to predict which sociodemographic

TABLE 2 Consumers attitudes and perception toward the impact of the COVID-19 pandemic on food security in the Caribbean.

Statements	SD <sup>a</sup>	D <sup>b</sup>	N <sup>c</sup>	A <sup>d</sup>	SA <sup>e</sup>
<b>Attitude</b>					
My household has adequate access to safe and nutritious food despite the COVID-19 pandemic	4.1	7.1	21.2	47.6	20.0
My country has adequate access to safe and nutritious food despite the COVID-19 pandemic	7.6	15.9	38.2	32.9	5.3
My household has enough food stock to last more than 1 month	7.6	25.3	24.7	34.1	8.2
Food prices have increased because of the COVID-19 pandemic	5.9	5.9	21.2	43.5	23.5
My ability to carry out livelihood activities was not affected by the COVID-19 pandemic	23.7	26.6	26	18.9	4.7
My household income has increased due to the COVID-19 pandemic	7.6	15.9	34.1	30.6	11.8
Providing food for me and my family is a high priority during the COVID-19 pandemic	5.3	1.2	20.0	49.4	24.1
I expect that my livelihood will continue to be impacted by the COVID-19 pandemic	5.9	6.5	32.4	41.2	14.1
Mean attitude	8.5	13.1	27.2	37.3	14.0
<b>Perception</b>					
I had difficulty eating enough food because of the COVID-19 pandemic	30.0	47.6	14.7	7.1	0.6
I am eating less preferred food because of the COVID-19 pandemic	18.2	42.9	20.0	16.5	2.4
I buy smaller quantities of food because of the COVID-19 pandemic	21.8	40.0	22.9	12.4	2.9
I purchase cheaper and less preferred foods because of the COVID-19 pandemic	20.0	33.5	23.5	19.4	3.5
I accept food aid because of the COVID-19 pandemic	31.8	36.5	21.8	10.0	0.0
Food stocks at home regularly run out during the COVID-19 pandemic	20.0	36.5	25.3	16.5	1.8
I felt that I was not eating balanced meals because of the COVID-19 pandemic	25.3	34.7	25.9	10.6	3.5
I am more concerned about providing food for my family because of the COVID-19 pandemic	13.5	18.8	28.2	30.6	8.8
I am now producing my own food because of the COVID-19 pandemic	18.2	29.4	26.5	21.8	4.1
My household income decreased because of the COVID-19 pandemic	12.4	26.5	24.1	28.2	8.8
Mean perception	21.12	34.64	23.29	17.31	3.64

<sup>a</sup>Strongly disagree.

<sup>b</sup>Disagree.

<sup>c</sup>Neutral.

<sup>d</sup>Agree.

<sup>e</sup>Strongly agree.

characteristics were associated with higher knowledge of food security and favorable attitude and perception to food security based on the impact of the COVID-19 pandemic. All statistical analyses were conducted using the Statistical Package for Social Sciences software (SPSS v. 28).

## Results

### Socio demographic characteristics of consumers

The socio-demographic characteristics of respondents are presented in Table 3. Most respondents were female (68.8%), in the age category 25–44 (51.8%), achieved tertiary education (81.2%) and from Trinidad and Tobago (68.2%). The majority lived in urban areas (57.6%), while 51.8% reported that their household size was between 4 and 6 members. In terms of respondent's role in the labor force, most (68.8%) were employed in various categories including private sector (28.8%), government employment (20.6%), and self-employment (19.4%). Some 25.3% of respondents were unemployed, 4.1% were students and 1.8% retired. The majority (67.1%) of respondents were not the main breadwinner of their household.

### Consumers' knowledge of food security

With respect to consumer's knowledge of food security, mean frequencies suggested that 84.8% of consumers were knowledgeable of the various dimensions of food security, while 15.2% were not (Table 1). Consumers had highest knowledge with respect to the statements "I know that having access to safe food is part of food security," and "I know that securing food stocks is part of food security." Lowest knowledge was reported with respect to the statements "I know that providing food aid contributes to food security," and "I know that having the necessary transport and market infrastructure in place is part of food security."

### Consumers' attitude toward the impact of COVID-19 on food security

The mean frequencies of the overall consumer attitude showed that 51.3% had a positive attitude to food security during the COVID-19 pandemic (37.3 and 14.0% agreed and strongly agreed, respectively, to the statements). Some 21.6% of consumers did not have a positive attitude toward the impact of the pandemic (8.5%

TABLE 3 Sociodemographic characteristics of consumers in the survey ( $n = 237$ ).

Socio-demographic categories	Description	Consumer (%) ( $n = 237$ )
Sex	Male	31.2
	Female	68.8
Age category (years)	<25	21.2
	25–44	51.8
	45–64	25.9
	≥65	1.2
Level of education	Primary school	0.6
	Secondary school	12.4
	Vocational/technical training	5.9
	Tertiary	81.2
	No formal education	0.0
Country or residence	Trinidad and Tobago	68.2
	Barbados	8.2
	Eastern Caribbean	14.1
	Jamaica	9.4
Rurality	Rural	42.4
	Urban	57.6
Household size (members)	1–3	42.9
	4–6	51.8
	≥7	5.3
Combined monthly household income (USD)	<500	8.2
	500–1,999	30.0
	2,000–3,999	32.4
	4,000–5,999	14.1
	6,000–7,999	6.5
	≥8,000	8.8
Employment status	Government employed	20.6
	Privately employed	28.8
	Self employed	19.4
	Unemployed	25.3
	Student	4.1
	Retiree/Pensioner	1.8
Breadwinner status	Breadwinner	32.9
	Non-breadwinner	67.1

strongly disagreed with the statements and 13.1% disagreed with the statements). Consumers agreed most with the statement “Providing food for me and my family is a high priority during the COVID-19 pandemic” with over 73.5% agreeing or strongly agreeing. Also, over 67% of consumers agreed with the statements “My household has adequate access to safe and nutritious food despite the COVID-19 pandemic” and “Food prices have increased because of the COVID-19 pandemic.” The highest disagreement was recorded for the statement “My ability to carry out livelihood activities was not affected by the

COVID-19 pandemic” with 26.5% disagreeing and 23.5% strongly disagreeing.

## Consumers’ perception of the impact of COVID-19 on food security

Most consumers (55.7%) had a positive perception toward the impact of the COVID-19 pandemic on food security and either strongly disagreed (21.1%) or disagreed (34.6%) with the negatively worded statements. Some 20.9% of consumers had a negative attitude toward the impact of the COVID-19 pandemic on food security. The highest level of disagreement was recorded for the statement “I had difficulty eating enough food because of the COVID-19 pandemic” with 47.6% and 30% disagreeing and strongly disagreeing, respectively, with the statement. Most consumers (68.3%) also disagreed with the statement “I accept food aid because of the COVID-19 pandemic.”

## Associations and relationship with consumers’ knowledge scores

Chi-square test of association showed that consumer knowledge was significantly associated with sex ( $\chi^2$ : 12.99, df: 2,  $p$ -value: 0.002), level of education ( $\chi^2$ : 34.22, df: 6,  $p$ -value: <0.001), combined monthly household income ( $\chi^2$ : 20.97, df: 10,  $p$ -value: 0.021) and breadwinner status ( $\chi^2$ : 20.97, df: 10,  $p$ -value: 0.021; Table 4). A significantly greater proportion of female consumers had high knowledge of food security (81.4%) compared to male consumers (63.2%; Table 2). A significantly larger proportion of tertiary graduates had high knowledge of food security (81.9%) compared to consumers with vocational/technical training (78.6%) and high school qualification (40.0%; Table 4). A significantly lower proportion of consumers from the combined monthly household income category of <500 USD had high knowledge of food security (52.6%) compared to the other income categories (Table 4). A significantly greater proportion of non-bread winners had low knowledge of food security (6.7%) compared to breadwinners (0.0%).

ANOVA test revealed that consumers’ mean knowledge scores were significantly different based on sex ( $F = 15.180$ ,  $p \leq 0.001$ ), age ( $F = 5.198$ ,  $p \leq 0.002$ ), education level ( $F = 19.273$ ,  $p \leq 0.001$ ), rurality ( $F = 5.534$ ,  $p \leq 0.019$ ) and income level ( $F = 3.500$ ,  $p \leq 0.005$ ; Table 5). Tukey’s *b post hoc* test indicated that female consumers had higher mean knowledge level ( $18.665 \pm 0.175$ ) of food security compared to male consumers ( $17.461 \pm 0.255$ ). Consumers in the age category <25 years had a significantly lower mean knowledge score ( $17.40 \pm 0.0288$ ) compared to those in the age category of 65 years or older which showed the highest mean knowledge score ( $20.00 \pm 1.286$ ). In terms of education, consumers that achieved up to secondary school education had the lowest mean knowledge score ( $16.18 \pm 0.365$ ) which was significantly different from other level of education categories. The results indicated that consumers that reside in rural areas tend to have significantly lower knowledge score ( $17.89 \pm 0.220$ ) of food security compared to those that reside in urban areas ( $18.59 \pm 0.199$ ). Furthermore, consumers from households with combined monthly income of <500 USD had the lowest mean knowledge score ( $16.26 \pm 0.512$ ) which was significantly different to all other household income categories. Consumers’ mean knowledge

TABLE 4 Consumers knowledge attitude, and perception proportions by socio-demographic characteristics using Chi-square comparisons.

Sociodemographic categories and descriptions	Knowledge <i>n</i> (%)			Attitude <i>n</i> (%)				Perception <i>n</i> (%)			
	Low	Fair	High	VF	F	UF	VU	VF	F	UF	VU
<b>Sex</b>	$\chi^2$ : 12.99, df: 2, <i>p</i> -value: 0.002			$\chi^2$ : 19.10, df: 3, <i>p</i> -value: <0.001				$\chi^2$ : 5.83, df: 3, <i>p</i> -value: 0.120			
Male	8 (10.5*)	20 (26.3)	48 (63.2)	11 (14.5)	35 (46.1)	24 (31.6)	6 (7.9)	13 (17.1)	44 (57.9)	19 (25.0)	0 (0.0)
Female	3 (1.9)	27 (16.8)	131 (81.4)	8 (5.0)	114 (70.8)	37 (23.0)	2 (1.2)	43 (26.7)	94 (58.4)	23 (14.3)	1 (0.6)
<b>Age category (years)</b>	$\chi^2$ : 12.00, df: 6, <i>p</i> -value: 0.062			$\chi^2$ : 9.09, df: 9, <i>p</i> -value: 0.429				$\chi^2$ : 17.50, df: 9, <i>p</i> -value: 0.014			
<25	5 (8.3)	19 (31.7)	36 (60.0)	2 (3.3)	36 (60.0)	20 (33.3)	2 (3.3)	5 (8.3)	47 (78.3)	8 (13.3)	0 (0.0)
25–44	5 (4.1)	21 (17.2)	96 (78.7)	11 (9.0)	78 (63.9)	27 (22.1)	6 (4.9)	36 (29.5)	59 (48.4)	26 (21.3)	1 (0.8)
45–64	1 (1.9)	7 (13.5)	44 (84.6)	6 (11.5)	32 (61.5)	14 (26.9)	0 (0.0)	14 (26.9)	30 (57.7)	8 (15.4)	0 (0.0)
≥65	0 (0.0)	0 (0.0)	3 (100)	0 (0.0)	3 (100.0)	0 (0.0)	0 (0.0)	1 (33.3)	2 (66.7)	0 (0.0)	0 (0.0)
<b>Level of education</b>	$\chi^2$ : 34.22, df: 6, <i>p</i> -value: <0.001			$\chi^2$ : 10.69, df: 9, <i>p</i> -value: 0.298				$\chi^2$ : 4.49, df: 9, <i>p</i> -value: 0.876			
Secondary School	6 (17.1)	15 (42.9)	14 (40.0)	0 (0)	22 (62.9)	13 (37.1)	0 (0.0)	6 (17.1)	22 (62.9)	7 (20.0)	0 (0.0)
Vocational training	0 (0.0)	3 (21.4)	11 (78.6)	1 (7.1)	8 (57.1)	5 (35.7)	0 (0.0)	1 (7.1)	10 (71.4)	3 (21.4)	0 (0.0)
Tertiary	5 (2.7)	29 (15.4)	154 (81.9)	18 (9.6)	119 (63.3)	43 (22.9)	8 (4.3)	49 (26.1)	106 (56.4)	32 (17.0)	1 (0.5)
<b>Country of residence</b>	$\chi^2$ : 9.21, df: 6, <i>p</i> -value: 0.162			$\chi^2$ : 8.11, df: 9, <i>p</i> -value: 0.523				$\chi^2$ : 9.08, df: 9, <i>p</i> -value: 0.430			
Trinidad and Tobago	6 (3.8)	32 (20.5)	118 (75.6)	9 (5.8)	102 (65.4)	38 (24.4)	7 (4.5)	32 (20.5)	95 (60.9)	28 (17.9)	1 (0.6)
Barbados	2 (10.0)	1 (5.0)	17 (85)	3 (15.0)	11 (55.0)	6 (30.0)	0 (0.0)	6 (30.0)	10 (50.0)	4 (20.0)	0 (0.0)
Eastern Caribbean	2 (4.7)	13 (30.2)	28 (65.1)	4 (9.3)	27 (62.8)	12 (27.9)	0 (0.0)	9 (20.9)	26 (60.5)	8 (18.6)	0 (0.0)
Jamaica	1 (5.6)	1 (5.6)	16 (88.9)	3 (16.7)	9 (50.0)	5 (27.8)	1 (5.6)	9 (50.0)	7 (38.9)	2 (11.1)	0 (0.0)
<b>Rurality</b>	$\chi^2$ : 3.63, df: 2, <i>p</i> -value: 0.163			$\chi^2$ : 5.36, df: 3, <i>p</i> -value: 0.147				$\chi^2$ : 2.36, df: 3, <i>p</i> -value: 0.501			
Rural	5 (4.7)	27 (25.2)	75 (70.1)	5 (4.7)	68 (63.6)	32 (29.9)	2 (1.9)	23 (21.5)	66 (61.7)	17 (15.9)	1 (0.9)
Urban	6 (4.6)	20 (15.4)	104 (80.0)	14 (10.8)	81 (62.3)	29 (22.3)	6 (4.6)	33 (25.4)	72 (55.4)	25 (19.2)	0 (0.0)
<b>Household size (members)</b>	$\chi^2$ : 6.63, df: 4, <i>p</i> -value: 0.156			$\chi^2$ : 14.46, df: 6, <i>p</i> -value: 0.025				$\chi^2$ : 11.73, df: 6, <i>p</i> -value: 0.068			
1–3	7 (6.8)	15 (14.6)	81 (78.6)	12 (11.7)	56 (54.4)	30 (29.1)	5 (4.9)	24 (23.3)	65 (63.1)	13 (12.6)	1 (1.0)
4–6	4 (3.4)	30 (25.4)	84 (71.2)	7 (5.9)	77 (65.3)	31 (26.3)	3 (2.5)	24 (20.3)	67 (56.8)	27 (22.9)	0 (0.0)
≥7	0 (0.0)	2 (12.5)	14 (87.5)	0 (0.0)	16 (100.0)	0 (0.0)	0 (0.0)	8 (50.0)	6 (37.5)	2 (12.5)	0 (0.0)
<b>Combine monthly household income (USD)</b>	$\chi^2$ : 20.97, df: 10, <i>p</i> -value: 0.021			$\chi^2$ : 17.58, df: 15, <i>p</i> -value: 0.285				$\chi^2$ : 29.19, df: 15, <i>p</i> -value: 0.015			
<500	4 (21.1)	5 (26.3)	10 (52.6)	2 (10.5)	8 (42.1)	8 (42.1)	1 (5.3)	2 (10.5)	10 (52.6)	7 (36.8)	0 (0.0)
500–1,999	2 (2.7)	16 (21.3)	57 (76.0)	4 (5.3)	50 (66.7)	15 (20.0)	6 (8.0)	16 (21.3)	40 (53.3)	18 (24.0)	1 (1.3)
2,000–3,999	2 (2.7)	15 (20.5)	56 (76.7)	5 (6.8)	50 (68.5)	17 (23.3)	1 (1.4)	20 (27.4)	49 (67.1)	4 (5.5)	0 (0.0)
4,000–5,999	1 (2.9)	8 (22.9)	26 (74.3)	3 (8.6)	20 (57.1)	12 (34.3)	0 (0.0)	11 (31.4)	15 (42.9)	9 (25.7)	0 (0.0)
6,000–7,999	0 (0.0)	3 (20.0)	12 (80.0)	2 (13.3)	10 (66.7)	3 (20.0)	0 (0.0)	1 (6.7)	14 (93.3)	0 (0.0)	0 (0.0)
≥8,000	2 (10.0)	0 (0.0)	18 (90.0)	3 (15.0)	11 (55.0)	6 (30.0)	0 (0.0)	6 (30.0)	10 (50.0)	4 (20.0)	0 (0.0)
<b>Employment status</b>	$\chi^2$ : 10.91, df: 10, <i>p</i> -value: 0.364			$\chi^2$ : 27.57, df: 15, <i>p</i> -value: 0.024				$\chi^2$ : 22.08, df: 15, <i>p</i> -value: 0.106			
Government employed	0 (0.0)	6 (13.3)	39 (86.7)	3 (6.7)	36 (80.0)	6 (13.3)	0 (0.0)	13 (28.9)	27 (60.0)	4 (8.9)	1 (2.2)
Privately employed	4 (6.0)	13 (19.4)	50 (74.6)	3 (4.5)	46 (68.7)	13 (19.4)	5 (7.5)	12 (17.9)	38 (56.7)	17 (25.4)	0 (0.0)
Self employed	1 (2.3)	11 (25.6)	31 (72.1)	6 (14.0)	20 (46.5)	17 (39.5)	0 (0.0)	17 (39.5)	21 (48.8)	5 (11.6)	0 (0.0)
Unemployed	6 (9.1)	15 (22.7)	45 (68.3)	5 (7.6)	38 (57.6)	20 (30.3)	3 (4.5)	10 (15.2)	44 (66.7)	12 (18.2)	0 (0.0)
Student	0 (0.0)	2 (16.7)	10 (83.3)	2 (16.7)	5 (41.7)	5 (41.7)	0 (0.0)	3 (25.0)	7 (58.3)	2 (16.7)	0 (0.0)
Retiree/ Pensioner	0 (0.0)	0 (0.0)	4 (100)	0 (0.0)	4 (100.0)	0 (0.0)	0 (0.0)	1 (25.0)	1 (25.0)	2 (50)	0 (0.0)
<b>Breadwinner status</b>	$\chi^2$ : 6.09, df: 2, <i>p</i> -value: 0.048			$\chi^2$ : 1.98, df: 3, <i>p</i> -value: 0.576				$\chi^2$ : 9.03, df: 3, <i>p</i> -value: 0.029			
Breadwinner	0 (0.0)	18 (24.3)	56 (75.7)	6 (8.1)	42 (56.8)	23 (31.1)	3 (4.1)	14 (18.9)	39 (52.7)	20 (27.0)	1 (1.4)
Non-breadwinner	11 (6.7)	29 (17.8)	123 (75.5)	13 (8.0)	107 (65.6)	38 (23.3)	5 (3.1)	42 (25.8)	99 (60.7)	22 (13.5)	0 (0.0)

TABLE 5 ANOVA model on the socio-demographic variables on consumers' knowledge of food security and attitude, and perception of the impact of the COVID-19 pandemic on household food security in CSIDs.

Demographic categories and descriptions	Knowledge level (Mean $\pm$ SEM*)	Attitude levels (Mean $\pm$ SEM)	Perception levels (Mean $\pm$ SEM)
<b>Sex</b>			
Male	17.461 $\pm$ 0.255b*	26.26 $\pm$ 0.662	25.28 $\pm$ 0.956
Female	18.67 $\pm$ 0.1175a	27.05 $\pm$ 0.445	24.54 $\pm$ 0.644
<i>F</i>	15.180	0.974	0.417
<i>p</i> -value	<0.001	0.325	0.519
<b>Age</b>			
<25	17.40 $\pm$ 0.288b	25.69 $\pm$ 0.798	26.22 $\pm$ 1.159
25–44	18.40 $\pm$ 0.202ab	26.85 $\pm$ 0.511	24.13 $\pm$ 0.741
45–64	18.90 $\pm$ 0.309ab	27.39 $\pm$ 0.722	25.02 $\pm$ 1.048
$\geq$ 65	20.00 $\pm$ 1.248a	32.00 $\pm$ 3.387	21.50 $\pm$ 4.917
<i>F</i>	5.198	1.648	0.942
<i>p</i> -value	0.002	0.180	0.422
<b>Level of education</b>			
Secondary school	16.18 $\pm$ 0.365b	26.05 $\pm$ 1.052	26.95 $\pm$ 1.518
Vocational training	18.79 $\pm$ 0.569a	27.20 $\pm$ 1.525	25.70 $\pm$ 2.200
Tertiary	18.61 $\pm$ 0.155a	26.94 $\pm$ 0.410	24.38 $\pm$ 0.592
<i>F</i>	19.273	0.342	1.335
<i>p</i> -value	<0.001	0.711	0.266
<b>Country of residence</b>			
Trinidad and Tobago	18.34 $\pm$ 0.184	26.82 $\pm$ 0.448	25.17 $\pm$ 0.642
Barbados	18.25 $\pm$ 0.513	28.14 $\pm$ 1.291	25.29 $\pm$ 1.848
Eastern Caribbean	17.88 $\pm$ 0.354	26.79 $\pm$ 0.986	24.92 $\pm$ 1.411
Jamaica	18.61 $\pm$ 0.541	25.56 $\pm$ 1.208	21.19 $\pm$ 1.729
<i>F</i>	0.584	0.711	1.592
<i>p</i> -value	0.626	0.547	0.193
<b>Rurality</b>			
Rural	17.89 $\pm$ 0.220b	26.26 $\pm$ 0.567	25.57 $\pm$ 0.818
Urban	18.59 $\pm$ 0.199a	27.20 $\pm$ 0.486	24.18 $\pm$ 0.701
<i>F</i>	5.534	1.586	1.656
<i>p</i> -value	0.019	0.210	0.200
<b>Household size (members)</b>			
1–3	18.29 $\pm$ 0.226	26.55 $\pm$ 0.565	24.58 $\pm$ 0.809
4–6	18.21 $\pm$ 0.212	26.84 $\pm$ 0.514	25.36 $\pm$ 0.736
$\geq$ 7	18.63 $\pm$ 0.574	28.56 $\pm$ 1.609	20.56 $\pm$ 2.303
<i>F</i>	0.242	0.698	2.029
<i>p</i> -value	0.785	0.499	0.135
<b>Combined monthly household income (USD)</b>			
<500	16.26 $\pm$ 0.512b	23.93 $\pm$ 1.272	28.00 $\pm$ 1.840
500–1,999	18.54 $\pm$ 0.259a	26.08 $\pm$ 0.667	25.86 $\pm$ 0.964
2,000–3,999	18.34 $\pm$ 0.261a	27.60 $\pm$ 0.642	22.98 $\pm$ 0.928
4,000–5,999	18.37 $\pm$ 0.377a	27.17 $\pm$ 0.972	25.12 $\pm$ 1.405
6,000–7,999	18.80 $\pm$ 0.576a	27.64 $\pm$ 1.435	24.27 $\pm$ 20.76
$\geq$ 8,000	18.35 $\pm$ 0.499a	27.87 $\pm$ 1.229	24.40 $\pm$ 1.778

(Continued)

TABLE 5 (Continued)

Demographic categories and descriptions	Knowledge level (Mean ± SEM*)	Attitude levels (Mean ± SEM)	Perception levels (Mean ± SEM)
<i>F</i>	3.500	1.810	1.648
<i>p</i> -value	0.005	0.114	0.150
<b>Employment status</b>			
Government employed	18.84 ± 0.340	27.86 ± 0.812	23.63 ± 1.166
Privately employed	18.18 ± 0.281	26.10 ± 0.686	26.08 ± 0.985
Self employed	18.30 ± 0.342	27.30 ± 0.836	23.27 ± 1.201
Unemployed	17.83 ± 0.281	25.98 ± 0.732	25.93 ± 1.052
Student	18.50 ± 0.658	27.86 ± 1.815	21.00 ± 2.607
Retiree/Pensioner	19.50 ± 1.140	30.00 ± 2.773	25.33 ± 3.982
<i>F</i>	1.334	1.205	1.523
<i>p</i> -value	0.251	0.309	0.185
<b>Breadwinner status</b>			
Breadwinner	18.42 ± 0.266	26.46 ± 0.645	25.93 ± 0.929
Non-breadwinner	18.20 ± 0.180	26.97 ± 0.452	24.20 ± 0.648
<i>F</i>	0.448	0.418	2.336
<i>p</i> -value	0.504	0.519	0.128

\*SEM, Standard error of the mean.

\*Values within sociodemographic category that share the same letters along the column are not significantly different.

TABLE 6 Correlation matrix of socio-demographic variables.

		A	B	C	D	E	F	G	H	I
A	Age	1.00								
B	Sex	0.08	1.00							
C	Country of Residence	-0.08	-0.18	1.00						
D	Rurality	0.06	0.10	-0.17	1.00					
E	Education	-0.08	0.15	-0.06	0.14	1.00				
F	Employment status	-0.27	0.04	-0.08	0.04	-0.03	1.00			
G	Household size (members)	-0.05	0.23	-0.28	-0.03	-0.01	-0.04	1.00		
H	Breadwinner status	-0.30	0.24	0.00	-0.04	0.11	0.38	0.21	1.00	
I	Monthly household income (USD)	0.09	0.00	-0.16	0.13	0.07	0.00	-0.07	0.15	1.00

scores did not significantly differ with country of residence, household size, employment status and breadwinner status.

Sociodemographic variables were not strongly correlated and attempts to include all in the univariate ordinal logistic analysis were unsuccessful (Table 6). However, seven of the nine variables were successfully included and three of those variables including sex, level of education, and combined household income were found to be significantly associated with knowledge levels of consumers (Table 7). The odds of a consumers having higher knowledge level of food security were 2.5 times lower for male consumers compared to female consumers. The odds of having higher knowledge level were 0.9 time lower for consumers with secondary school education when compared to tertiary graduates (Table 7). Consumers from households with a combined monthly income of <500 USD were 0.2 times less likely to have a higher knowledge score of food security compared to consumers from the category >8,000 USD (Table 7).

### Associations and relationship with consumers’ attitude and perception

Chi-square test of association showed that consumers’ attitude was significantly associated with sex ( $\chi^2$ : 19.10, df: 3, *p*-value: <0.001), household size ( $\chi^2$ : 14.46, df: 6, *p*-value: 0.025), and employment status ( $\chi^2$ : 27.57, df: 15, *p*-value: 0.024; Table 4). Higher proportion of females had favorable attitude toward food security (70.8%) compared to male consumers (46.1%). A greater proportion of consumers from households with 1–3 members have an unfavorable and very unfavorable attitude toward food security (29.9 and 4.9%, respectively) compared to those from household seven or more members (0%; Table 4). A higher proportion of government employees had favorable attitude toward food security (80%) compared to self-employed consumers (46.5%; Table 4).



TABLE 7 Results of univariate ordinal logistic model for consumers' knowledge, attitude, and perception of the impact of COVID-19 on food security in the Caribbean.

Sociodemographic categories and descriptions	Knowledge			Attitude			Perception		
	$\beta$	OR	95% CI	$\beta$	OR	95% CI	$\beta$	OR	95% CI
<b>Sex</b>									
Male	-1.38	0.25	-2.20 to -0.565 *	0.10	1.11	-0.64 to 0.84	0.34	1.41	-0.37 to 1.06
Female	Ref			Ref			Ref		
<b>Age category (years)</b>									
<25				0.56	1.74	-3.00 to 4.11	1.35	3.87	-1.95 to 4.65
25-44				0.20	1.22	-3.26 to 3.66	0.85	2.35	-2.35 to 4.06
45-64				0.05	1.05	-3.42 to 3.51	0.46	1.58	-2.74 to 3.65
≥65				Ref			Ref		
<b>Level of education</b>									
Secondary School	-2.45	0.09	-3.40 to -1.50 *	0.38	1.47	-0.63 to 1.39	0.26	1.29	-0.74 to 1.25
Vocational training	0.20	1.22	-1.58 to 1.98	0.05	1.05	-1.40 to 1.49	0.56	1.76	-0.82 to 1.95
Tertiary	Ref.			Ref			Ref		
<b>Country of residence</b>									
Trinidad and Tobago	-1.70	0.18	-3.50 to 0.10	0.08	1.08	-1.16 to 1.32	1.63	5.11	0.37-2.89*
Barbados	-2.10	0.12	-4.36 to 0.16	-0.48	0.62	-2.16 to 1.20	1.65	5.18	0.002-3.29*
Eastern Caribbean	-1.93	0.15	-3.97 to 0.11	-0.54	0.58	-2.09 to 1.02	1.30	3.67	-0.24 to 2.84
Jamaica	Ref			Ref			Ref		
<b>Rurality</b>									
Rural	0.73	2.06	-0.32 to 1.78	0.44	1.55	-0.26 to 1.14	-0.14	0.87	-0.81 to 0.54
Urban	Ref			Ref			Ref		
<b>Household size (members)</b>									
1-3	-1.86	0.16	-3.77 to 0.06*	0.89	2.43	-0.75 to 2.53	1.36	3.89	-0.22 to 2.93
4-6	-2.52	0.08	-4.41 to -0.64*	0.76	2.13	-0.86 to 2.38	1.90	6.71	0.34-3.47*
≥7	Ref			Ref			Ref		
<b>Combine monthly household income (USD)</b>									
<500	-3.98	0.02	-6.01 to -1.95 *	0.76	2.14	-0.94 to 2.47	1.46	4.30	-0.22 to 3.13
500-1,999	-1.06	0.35	-2.76 to 0.63	0.34	1.40	-0.98 to 1.65	0.67	1.96	-0.59 to 1.93
2,000-3,999	-0.81	0.45	-2.52 to 0.90	0.02	1.02	-1.27 to 1.31	-0.45	0.64	-1.68 to 0.78
4,000-5,999	-1.55	0.21	-3.31 to 0.21	0.34	1.41	-1.09 to 1.77	0.42	1.53	-0.95 to 1.79
6,000-7,999	-1.00	0.37	-3.15 to 1.16	-0.13	0.88	-1.84 to 1.58	0.31	1.36	-1.30 to 1.91
≥8,000	Ref			Ref			Ref		
<b>Employment status</b>									
Government employed				0.37	1.45	-2.52 to 3.26	-0.58	0.56	-3.22 to 2.07
Privately employed				0.72	2.06	-2.15 to 3.59	-0.53	0.59	-3.16 to 2.09
Self employed				1.06	2.89	-1.78 to 3.90	-0.77	0.46	-3.37 to 1.82
Unemployed				0.86	2.35	-2.06 to 3.77	-0.54	0.59	-3.21 to 2.14
Student				1.36	3.90	-1.94 to 4.67	-0.56	0.57	-3.64 to 2.51
Retiree/Pensioner				Ref			Ref		
<b>Breadwinner status</b>									
Breadwinner	0.74	2.09	-0.28 to 1.75	0.40	1.49	-0.44 to 1.23	0.81	2.24	-0.01 to 1.62*
Non-breadwinner	Ref			Ref			Ref		

$\beta$  - Estimate. \*Significant at the 5% level ( $p < 0.05$ ). Ref, Reference category.

In terms of perception, Chi-square test of association showed that consumers' perception was significantly associated with age ( $\chi^2$ : 17.50, df: 9,  $p$ -value: 0.014), combined monthly household income ( $\chi^2$ : 29.19, df: 15,  $p$ -value: 0.015) and breadwinner status ( $\chi^2$ : 9.03, df: 3,  $p$ -value: 0.029) (Table 4). A significantly higher proportion of consumers in the age category <25 years old had a favorable perception of food security (78.3%) compared to those consumers who were between 45–65 years old (57.7%). Additionally, a significantly higher proportion of consumers in the 25–44 age category had a highly favorable perception compared to those in the age category <25 years old. (8.3%). A significantly lower proportion of consumers from households with combined monthly income of 2,000–3,999 USD had an unfavorable perception (5.5%) compared to those in the income categories <500 USD (36.8%), 500–1,999 USD (24.0%) and 4,000–5,999 USD (25.7%) (Table 4). A significantly higher proportion of breadwinners had an unfavorable perception of the COVID-19 pandemic impact on food security (27%) compared to non-breadwinners (13.5%) (Table 4).

ANOVA tests indicated that consumers' mean attitude and mean perception scores were not significantly different for any of the socio-demographic variables evaluated (Table 4). All nine socio-demographic variables were successfully included in the univariate ordinal logistic regression model for both attitude and perception (Table 7). None of the socio-demographic variables were found to be significantly associated with attitude. However, three sociodemographic variables including country of residence, household size and breadwinner status were all significantly associated with perception. The odds of consumers having a more favorable perception of food security was 5.11 times higher for consumers from Trinidad and Tobago, 5.18 times higher for consumers in Barbados and 3.67 times higher for consumers in the Eastern Caribbean compared to the reference category Jamaica (Table 7). With respect to household size (members) the odds of consumers having a favorable perception was 3.89 times higher for consumers from households with 1–3 members and 6.71 time higher for consumers from households with 4–6 members compared to the reference category of households with 7 or more members (Table 7). Based on breadwinner status, the odds of a consumer having a favorable perception was 2.24 times higher for those consumers who were the breadwinner of their families (Table 7).

## Discussion

The COVID-19 pandemic presented unprecedented challenges to food systems and food security across the globe. Many feared that there would be an increase in food insecurity which would be expected to affect the most vulnerable consumers in society. These factors were also likely to affect consumers food purchasing behavior, meal preparation and eating habits. Several reports and commentaries suggested that the pandemic impacted food dynamics in the Caribbean region and an understanding of this among consumers is critical to developing approaches toward achieving food and nutrition security (Blazy et al., 2021; CARICOM et al., 2021; Marshall et al., 2021; Daley et al., 2022). The Caribbean COVID-19 Food Security and Livelihoods Impact Survey reported that food insecurity remains a concern, with many consumers having to reduce their food consumption and average household food stocks continued to decrease (CARICOM et al., 2021). However, the extent of these

impacts and the dynamics among Caribbean consumers have not been investigated. This study investigated how various sociodemographic factors influenced consumers knowledge of food security along with their attitude, and perception of the impact of the COVID-19 pandemic on household food security in the CSIDs.

The results of this study indicated that overall, Caribbean consumers were very knowledgeable of the dimensions of food security. However, it was clear that the COVID-19 pandemic impacted food access, availability, utilization, and stability. The majority of respondents had favorable attitude and perception in relation to the impact of COVID-19 on food security. This could be due to the fact that although measures were put in place to protect public health which resulted in reduced economic activity with negative impacts on production, distribution and consumption, there was a surge in e-commerce and accelerated digital transformation (Deconinck et al., 2020; Sneider and Singhal, 2021). Although it is true that negative effects were not felt equally across all sociodemographic categories and some persons were more vulnerable than others, the overall pictures point to a region where consumers responded to the COVID-19 pandemic in various ways to maintain their household food security (Daley et al., 2022). Recent studies showed that panic buying, food hoarding, and home gardening were some of the activities that increased because of the COVID-19 pandemic and may have increased consumer knowledge of the dimensions of food security (Blazy et al., 2021; Daley et al., 2022).

In term of sex or gender, female consumers generally had higher knowledge of food security than their male counterparts. However, it is also noteworthy that this study had a higher proportion of females, which coupled with the relatively small sample size of the study could introduce some bias in the analysis. Nevertheless, the odds ratio indicated that male consumers were 0.25 times more likely to fall into a lower knowledge category than female consumers although there were no significant differences in attitudes and perceptions between males and females based on odds ratio. Other studies also reported sex or gender differences relating to knowledge and other aspects of food security. A previous study done in Latin America and the Caribbean reported that female and non-binary genders were found to have higher food insecurity compared to males (Benites-Zapata et al., 2021). This higher risk of experiencing food insecurity was likely a major factor that caused female consumers to become more aware of issues of food security. In Caribbean societies, females tend to have a greater commitment to unpaid family and household work (Pastore et al., 2021). This commitment and desire to improve the wellbeing of their family or household, as well as lower aversion to risk, likely translate into having more concern and awareness of food security issues. These qualities may also cause female consumers to take greater precaution when it comes to securing household food security. Similar sex and gender discordance have been reported in studies looking at household food security. Wang et al. (2020) reported that because females were more risk averse, they were more likely to reserve larger scale food reserves than males when it comes to food security in China. A study that looked at the role of cash transfers in enhancing food security in South Africa reported that food insecurity decreases in households headed by males compared to households headed by females, which also consume less food (Mncube et al., 2023). Similarly, Ganpule et al. (2023) reported that female headed households, especially among rural areas in north and south India experienced significantly higher food insecurity than their male counterparts,

which could be linked to inequities such as access to lower amount of food and lower consumption of nutrient rich food.

The results of this study showed that consumers that were in the age category <25 years old had significantly lower knowledge of food security than consumers  $\geq 65$  years old. These were the youngest and the oldest age categories used in the survey. Although the association between age and knowledge level was not significant, there was a low proportion of consumers with high knowledge in the <25 years old category. It was hypothesized that older consumers, because of more experience and increased responsibilities were likely to be more knowledgeable and have more favorable attitudes and perceptions to food security. However, analyzing the knowledge, attitude and perception levels among age categories can be very complicated because many other socio-economic factors could influence individuals. Nevertheless, the results of this study showed similar inferences to a previous study conducted in the Caribbean where an increasing age was associated with a lower prevalence of food insecurity (Benites-Zapata et al., 2021). In northern Italy, a study investigating the effects of the imposed lockdown on food insecurity and other factors reported that parents' of higher age (over 50) was protective against food insecurity (Dondi et al., 2021). Similarly, an online survey performed between May and June on adults living in Tasmania, Australia also found that increasing age was protective against food insecurity (Kent et al., 2020).

Several studies found that education positively contributed to food security or was a protective factor against food insecurity of households (Abu and Soom, 2016; Kent et al., 2020; Getaneh et al., 2022). This is based on the premise that with higher education, individuals will be able to improve their productivity or have access to better employment opportunities in the labor market (Maharjan and Khatri-Chhetri, 2006; Abu and Soom, 2016). Education is also considered to be a means for food security improvement because educated individuals are more likely to practice family planning programs resulting in smaller family size with more manageable food demands (Getaneh et al., 2022). The results of this study showed that consumers with secondary school education had significantly lower knowledge of food security compared to consumers with vocational or tertiary training and respondents from smaller households had a more favorable perception of the impact of COVID-19 on food security. Furthermore, there were significantly higher proportions of tertiary and vocational training graduates with higher knowledge of food security compared to high school graduates. There were no significant associations between education and attitude or perception, nor was there any correlation between education level and any of the other sociodemographic variables. Nevertheless, from the assessment of consumer knowledge, the findings of this study shows agreement with those reported by Kent et al. (2020) where it was reported that respondents with a diploma or high-school qualification showed a two-fold increase in the odds of experiencing food insecurity compared to those with a university-level education (Bachelor's degree or higher). From the current study, secondary school graduates had a 9% odds of falling into a lower knowledge category compared to tertiary trained graduates (Table 7). Lack of education has also been recognized as a barrier to healthy food choices that prevent some consumers from purchasing foods according to their values (Kneafsey et al., 2013).

Other studies have reported differences in response to food security based on rurality and the present study contributes to this area. In this study, consumers from urban areas had a significantly higher

knowledge of food security compared to consumers from rural areas, although there were no significant differences in attitudes and perception and there were no significant associations. The results of this study suggest that urban consumers may have greater awareness of issues regarding the availability and access to food, especially during the COVID-19 pandemic. This may be as a consequence of stronger enforcement of restrictions on movement in urban areas compared to rural areas where there is generally less pressure or concern for food security, since most agricultural activities are conducted in rural areas (Connors et al., 2021; Huang et al., 2021). A study in France suggested that living in rural areas was a protective factor against the COVID-19 pandemic as those persons generally had better social support, greater family presence, less frequent feeling of imprisonment, had a garden, fewer depressive symptoms and lower anxiety scores (Pèrès et al., 2021). Our results may also be interpreted in the context of a study done by Roy-Macauley (2002) which found that rural people strive to feed themselves while the urban population spends more than 70% of its earnings on food, leaving only 30% for other minimum basic needs such as housing, education, healthcare, water and livelihoods, which in a pandemic may cause greater concern over food security. Abu and Soom (2016) also reported that the high cost of food items was not significant in the rural areas with low loading, implying that rural people spent less on food items. On the other hand, other studies have reported higher levels of food insecurity among rural populations. Kent et al. (2020) reported that during the COVID-19 pandemic in Tasmania, Australia, reduced access to food and fewer shops in rural areas coupled with media reports of price gouging of foods in response to increased demand, may have infringed upon the ability of rural residents to buy enough healthy food to meet their needs. Furthermore, in Latin America and the Caribbean, Benites-Zapata et al. (2021) reported that higher food insecurity in rural areas may be related to the predominance of informal businesses and situations of extreme poverty in these areas, despite having easier access to self-produced food during the COVID-19 pandemic.

Household income is one of the most consistent and often the strongest predictor of food insecurity reported in published literature (Abu and Soom, 2016; Kent et al., 2020; Benites-Zapata et al., 2021). In this study, consumers in the lowest income category having a combined monthly household income of <500 USD showed the lowest knowledge of food security. This group was also significantly underrepresented in terms of high knowledge of food security, and they also had a significantly higher proportion of highly unfavorable perception of the impact of the COVID-19 pandemic on household food security. Our results also showed that there was a significant 2% odds of this group falling into a lower knowledge category when compared to consumers from households with combined monthly income of  $\geq 8,000$  USD. Closely related to household incomes are employment and breadwinner status. In the present study, government employed consumers had favorable attitudes to the impact of the COVID-19 pandemic on household food security compared to self-employed consumers. This may be a direct relation to the fact that while many self-employed consumers lost some or all of their income stream due to the lockdown restriction measures imposed, government employees in the sampled countries continued to receive their salaries although in many cases they had to work from home (Mulder, 2020). Breadwinners have the responsibility of ensuring that their family has sufficient food. This responsibility may have contributed to their higher level of unfavorable perceptions of the COVID-19 impact on household

food security. These results combined may be indicative of higher vulnerability to food security among lower income households as well as higher income as a protective factor against food insecurity during the COVID-19 pandemic.

Loss of income was also very widespread during the pandemic because of the restriction imposed in many countries that prevented people from going out to their jobs (Eriksson et al., 2020; Huang, 2020; Sharma et al., 2020). Loss of income not only reduces the amount of money available for food, but it forces people to change their lifestyle including eating less preferred food which is an important part of food security. A recent study in the Caribbean showed over 25.5% of consumers in the study experienced loss of income which was significantly more associated with poorer families and smaller businesses (Daley et al., 2022). The findings of our study is congruent with other studies from other countries and regions. Kent et al. (2020) reported that in Tasmania, Australia, household income was independently associated with food insecurity, with incomes above AU\$80,000/year seemingly protective against food insecurity, and incomes below AU\$40,000 per year associated with a two-fold increase in the odds of food insecurity during the COVID-19 pandemic. In the same study, food insecurity was not limited to only those on low incomes, but loss of income at any level above 25% contributed to substantially higher odds of experiencing food insecurity (Adesiyun et al., 2014). In another study which sought to estimate the prevalence of moderate to severe food insecurity (MSFI) in Peru, the authors reported that people with low income (<255 US\$/month) before the COVID-19 pandemic as well as those whose income was significantly reduced during the pandemic period were more likely to experience MSFI (Cañari-Casaño et al., 2021). Dondi et al. (2021) from their study in Italy, concluded that household food insecurity was increasing in the early months of the COVID-19 pandemic even among wealthier areas but persons with lower income and disposable means were especially at risk. They further reported that weight gain and pediatric obesity are strictly linked to food insecurity among low-income groups (Dondi et al., 2021). This may be indicative of unhealthier food choices which are likely associated with loss of income. Being able to access healthy preferred food is an important part of food security and the inability to do so may contribute to higher incidences of non-communicable diet related diseases. This is usually a problem among lower income households because healthier diets are generally more costly. A study conducted in Trinidad and Tobago in 2017 before the COVID-19 pandemic reported that the cost of improving diets to ensure compliance with the Institute of Medicine (IOM) standards was approximately 45 US dollars per month or 540 US dollars per year which represents a substantial cost especially for larger families (Rocke et al., 2017). Considering the rise in inflation and socioeconomic issues associated with COVID-19, this situation may worsen and could cause increases in chronic non-communicable diseases which are already major contributors to illnesses and death throughout the Caribbean (Alcaraz et al., 2023; Alleyne et al., 2023; Cunningham-Myrie et al., 2023).

## Conclusions and recommendations

Assessment of the sociodemographic factors that influence consumer knowledge of food security and their attitude and

perception to the impact of the COVID-19 on household food security in CSIDs is important to help develop effective data driven decision making and interventions for pandemics and other international crises. Given the current global geopolitical and economic conditions, these crises are likely to occur more frequently and will have significant impacts on countries or regions with high import dependency. Continued monitoring of those factors that affect food security is also needed to support complete recovery from the COVID-19 pandemic especially given the compounding effects of other current international crises including the ongoing Russia-Ukraine conflicts.

The results of this study indicate that overall, Caribbean consumers were knowledgeable about food security and its various dimensions. Despite most consumers having favorable attitudes and perceptions toward the impact of the COVID-19 pandemic on household food security, there were significant associations with sociodemographic variables and differences in the odds of experiencing food insecurity which suggest different levels of vulnerability among consumers in the CSIDs. Male consumers were more likely to have lower knowledge of food security than female consumers. As expected, tertiary graduates were more likely to have higher knowledge of food security than respondents of lower education background. Consumers of low economic status were more likely to have lower knowledge of food security than consumers of high economic status. Furthermore, the results of this study showed that consumers residing in Jamaica were likely to have a lower perception of the impacts of COVID-19 compared to respondents from other countries covered in the survey. Additionally, smaller households were more likely to have a more favorable perception of the impact of the COVID-19 pandemic. The response measures instituted by governments, non-governmental and private sector organizations should consider these differences and variations among respondents to improve the efficiency and effectiveness of the measures implemented. Therefore, this study contributes to a better understanding of the nature of food security and consumer demographics in CSIDs. It also highlights some of the major factors to be considered for crises intervention.

## Limitations

The results must be understood within the context of some limitations. Firstly, this was a cross-sectional study, and the outputs were descriptive, and inferences were limited by study design, sample size and statistical methods used. The use of online recruitment tools has inherent limitations such as the need for participants to be literate and have internet access. Because of this, the use of online surveys may have excluded some groups or limited the number of respondents from some sociodemographic categories. There was a notably higher proportion of female to male respondents and a relatively small number of respondents. These are not reflective of the proportion in the general population and could have introduced biases which may impact the interpretation of the results obtained. Furthermore, the timing of the survey may have had an impact on respondents' views and their views may be different if they had a longer time to reflect on their responses or had face-to-face interactions with surveyors. This likely impacted respondents' attitudes and perceptions to the stated issues. Therefore, the findings presented should not

be generalized, but rather taken in the context of consumers in the sampled countries and sociodemographic categories who had access to the various online resources used to collect data. It is recommended that future studies should use a combination of methods for data collection. Furthermore, these studies should also explore the effectiveness of intervention strategies and ways to reorganize and build resilience in the food systems of CSIDs.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by The University of the West Indies. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## Author contributions

OD and W-AI conceived and developed the questionnaire. OD, W-AI, AJ, and RR conducted the surveys. OD and DP performed quantitative analysis. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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