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COVID-19's impact on urban food security in Benin: Evidence from household dietary changes

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Abstract

The COVID-19 pandemic and associated response measures significantly affected household food consumption and security. In Benin, the most stringent intervention was the establishment of a sanitary cordon to restrict movement. This study examines the impact of the pandemic on urban household diets and consumption behaviours, as well as their coping strategies. A total of 149 households were randomly selected across four cities, both within and outside the sanitary cordon. Data on food consumption, dietary diversity, and expenditure were collected for 2019 and 2020, covering pre-, during, and post-pandemic periods. Findings reveal that dietary diversity declined more sharply within the sanitary cordon – up to 11.9 % for male heads of households, and 7.2 % and 5.3 % for female heads of kitchens inside and outside the cordon, respectively. Children under five experienced reductions of 2.7 % and 6.0 %, respectively. Meat consumption was the only dietary component significantly affected, while household income remained stable. To cope, households relied on savings, borrowed money, and cut non-food expenses. These findings highlight the vulnerability of urban food systems to mobility restrictions and provide insights for designing adaptive responses to future public health crises.

Keywords: coping strategies, food diversity, income, sanitary cordon

1 Introduction

The COVID-19 pandemic, first identified in Wuhan in late 2019 (Dong *et al.*, 2020; Zhou *et al.*, 2020), rapidly evolved into a global health and economic crisis. Government responses, including lockdowns, mobility restrictions, and border closures, disrupted supply chains, reduced labour availability, and weakened food systems worldwide (OECD, 2020; ILO, 2020; Martin *et al.*, 2020). Several studies warned that these disruptions would particularly affect agriculture and food security in developing countries (Mees, 2020; Siche, 2020; FAO, 2020; Laborde *et al.*, 2020).

Benin, like many sub-Saharan African countries, experienced multiple waves of the pandemic beginning in March 2020. Although the country recorded relatively few COVID-19-related deaths, the socioeconomic impacts were substantial in a context of widespread poverty (36.2 percent) and pre-existing food insecurity (INStaD, 2023). Prior to the pandemic, 47.5 percent of households were food secure, while 9.6 percent were food insecure, including 0.7 percent severely (AGVSA, 2017). The establishment of a sanitary cordon to isolate the most affected cities was the strictest national measure implemented. While designed to contain viral transmission, this intervention likely amplified disruptions to food supply chains and household access to diverse diets, especially in urban areas dependent on rural and imported food sources (HLPE, 2020; Torero, 2020).

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Evidence from other African countries shows that COVID-19 increased food insecurity, reduced dietary diversity, and negatively affected household incomes (Headey and Ruel, 2020; Chiwona-Karltun *et al*., 2021; Kansiime *et al*., 2021; Shupler *et al*., 2021). In Benin, impacts on firms and informal production units included significant declines in turnover and sales (Chabossou *et al*., 2022; Amegnaglo *et al*., 2024), suggesting wider repercussions for household livelihoods.

However, most existing studies focus on national trends rather than household-level responses, despite evidence that shocks affect household members differently depending on gender roles, income sources, and responsibilities. Urban households, which rely heavily on markets and informal food vendors, may be particularly vulnerable to disruptions in mobility and supply chains.

This study contributes to the literature by analysing the effects of the COVID-19 pandemic on dietary diversity, consumption behaviour, and coping strategies of urban households in Benin. By comparing households located inside and outside the sanitary cordon across pre-, during-, and post-restriction periods, we provide new insights into how mobility restrictions shaped intra-household dietary outcomes and resilience strategies during the first wave of the pandemic.

2 Materials and methods

2.1 Study area and sampling

The study was carried out in southern Benin (Fig. 1). A multi-stage cluster-based random sampling approach was used to select the respondents of the study. The first stage consisted of the stratified random sampling approach considering their location relative to the security cordon (SC) established during the COVID-19 pandemic Two cities were selected within the SC zone (Abomey-Calavi and Porto-Novo), at the heart of the health crisis, and two outside the SC (Bohicon and Comè), allowing for a comparative analysis between areas directly affected by strict health restrictions and those that were relatively less impacted. This approach ensures a balanced representation of contrasting urban contexts and supports consistent interpretation of the results regarding household dietary adaptation strategies during the pandemic.

In the second stage, for each selected city, two districts were randomly chosen based on a comprehensive list of all available urban districts. In the third and final stage, respondents were randomly selected within each district using a structured questionnaire. The initial basis for selection was a listing of households within each selected district. However, since all surveyed households had to meet specific criteria (i.e., being biparent and monogamous to reduce heterogeneity linked to household structure. Polygamous households often have multiple kitchens and different decision-makers, which complicates comparisons of dietary behaviour), the random selection was applied within a filtered pool of eligible households that matched these conditions.

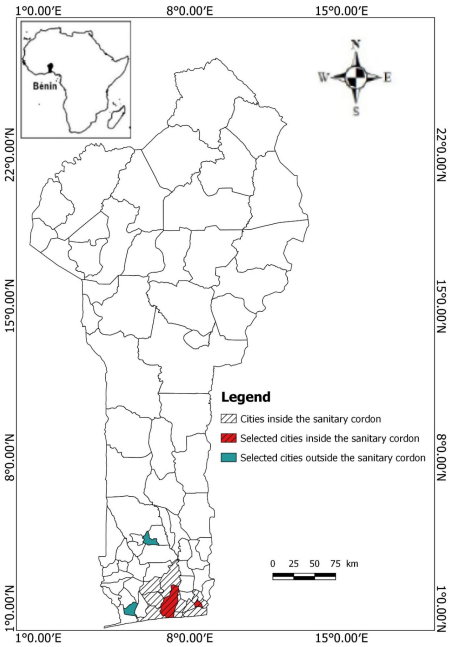

Fig. 1: *Map of Benin showing the selected cities. Source: Authors' own elaboration*

Urban households were targeted due to their sensitivity to the disruption of the food chain caused by the SC. Indeed, urban households depend highly on rural areas for agricultural products and on imported manufactured products. At least 35 households were randomly surveyed in each of the selected cities, with a total of 149 households surveyed (Table 1). All the households were biparent households to test the differential impact of COVID-19 within household members and monogamic to reduce the bias associated with multiple kitchens within the same household. In each household, the man was the head of the household (HOH), and the woman was the head of the kitchen (HOK). If available, any children under five years old were targeted and surveyed. In the socio-cultural and biparent household context of Benin, the HOH is the one with the final decision-making authority and responsibility for the basic needs, especially food needs, of the other household members. The HOK is generally the person with decision-making authority in the kitchen, especially about the food choice and composition and, therefore, the diet of the other household members.

Table 1: *The number of households surveyed in each selected city, both inside and outside the sanitary cordon (SC).*

City status	*City*	*Sample size*
In-SC	Abomey-Calavi	38
	Porto-Novo	35
Out-SC	Bohicon	35
	Comè	41
Total		149

2.2 Data collection

Three periods of the pandemic's first wave in 2020 were considered for data collection: the pre-pandemic period before the sanitary cordon (SC) (January to March 2020), the pandemic period during the SC (April to July 2020), and the post-pandemic period after the SC (September to November 2020). In addition, data were collected for the same periods in 2019, which served as the baseline year. Data were gathered through individual interviews using a digitised questionnaire administered to the Head of Household (HOH) and the Head of Kitchen (HOK). For children under five years old, questions were addressed to the HOK or the primary caregiver. Children over five were not included in the dietary assessment, as the under-five age group represents the most nutritionally vulnerable demographic and serves as a sensitive indicator of acute household food insecurity (Kennedy *et al.*, 2011). The data collected included socio-demographic characteristics, dietary diversity, and coping strategies used in response to food price increases or financial constraints. These included both asset-based and livelihood-based coping strategies.

2.3 Participants in the study

The study involved 149 households selected based on specific criteria to ensure homogeneity and comparability. Eligible households were required to be biparental and monogamous. This criterion was applied to reduce heterogeneity linked to household structure, as polygamous households often possess multiple kitchens and complex decision-making dynamics that complicate dietary analysis.

2.4 Data analysis

Dietary data were used to compute the Individual Dietary Diversity Score (IDDS) for each household member (HOH, HOK, and children under five), following established FAO guidelines (Ruel, 2002; Kennedy *et al.*, 2011). For each period and household member, two-sample t-tests compared IDDS between 2019 (baseline) and 2020 (pandemic year).

To assess the specific effect of the sanitary cordon (SC), a difference-in-differences (DID) framework was applied through a linear regression model. The model included the following factors: year (2019/2020), city status (inside/outside SC), period (pre-, during, and post-SC), type of household member, education level, gender, and ethnic group. Interaction terms were incorporated to test whether the effect of the SC varied across periods or household members. The fitted model is illustrated in the following equation.

$$\begin{aligned}\text{IDDS} = {} & \alpha_0 + \alpha_1\,\text{Year} + \alpha_2\,\text{City status} + \alpha_3\,\text{Period} \\ & + \alpha_4\,\text{Gender} + \alpha_5\,\text{Household member type} \\ & + \alpha_6\,\text{Education level} + \alpha_7\,\text{Gender} + \alpha_8\,\text{Ethnic group} \\ & + \alpha_9\,(\text{Year}:\text{City status}) \\ & + \alpha_{10}\,(\text{Year}:\text{City status}:\text{Period}) \\ & + \alpha_{11}\,(\text{Year}:\text{City status}:\text{Household member type}) \\ & + \varepsilon\end{aligned}$$

The DID term (Year × City status) captures the net effect of the SC on dietary diversity, while the three-way interactions evaluate heterogeneity in this effect. Model fit and significance were evaluated using ANOVA.

For each food group, consumption rates (CR) were calculated as the proportion of respondents who reported consuming the item during the reference period. Chi-square tests examined differences in CR by year and city status.

Income data were analysed using the differences between income before, during, and after COVID-19. Two-sample t-tests compared income changes between households inside and outside the SC for HOH and HOK. An ANOVA model was used to assess the contribution of sociodemographic variables to income variation.

Coping strategies were analysed through the reduced Coping Strategy Index (rCSI) following Maxwell and Caldwell (2008). For each period, t-tests compared rCSI values between 2019 and 2020, and a DID model assessed the effect of the SC. The frequency of citation of each coping strategy was computed, and chi-square tests were used to detect differences across years. All analyses were performed in R software version 4.1 (R Core Team, 2021).

3 Results

3.1 Socio-demographic characteristics of the surveyed households

The analysis of socio-demographic characteristics reveals distinct geographical and structural disparities among the 149 surveyed households (Tables 2 and 3). While the mean

household size remained relatively consistent across most cities, Abomey-Calavi stood out with slightly larger families. A more striking divergence was observed in housing tenure: Abomey-Calavi was predominantly characterised by rental accommodation, whereas home ownership was the norm in Porto-Novo, Bohicon, and Comè.

Table 2: *Socio-demographic characteristics of households.*

	in-Sc		out-Sc	
Variable	*Abomey-Calavi*	*Porto-Novo*	*Bohicon*	*Comè*
HH size	5 (1.50)	4 (0.96)	4 (1.10)	4 (1.26)
HOH age	37 (8.39)	48 (11.18)	45 (11.60)	45 (13.72)
HOK age	31 (4.99)	37 (7.72)	35 (9.82)	39 (12.40)
Housing status (%)				
Rental	73.05	37.14	34.28	26.83
PP	28.95	62.86	65.72	73.17

Note: Sc = sanitary cordon; HH = household; HOH = head of household; HOK = head of kitchen; PP = private property; Standard deviation in brackets.

Regarding individual characteristics (Table 3), a consistent age gap was evident, with Heads of Households (HOH) consistently older than Heads of Kitchens (HOK) across all locations. Education levels highlighted both a gender and a geographical divide. Generally, HOH possessed higher educational attainment than HOK. Furthermore, respondents in Comè and Abomey-Calavi reported significantly higher rates of university education compared to those in Bohicon and Porto-Novo, a variation likely attributable to the specificities of the sampled clusters rather than systematic urban differences.

Table 3: *Distribution of respondents according to the type of household member and education level.*

	Education level (%)				
Cities	*Uneducated*	*Literate*	*Primary*	*Secondary*	*University*
Head of household					
Comè	2.44	17.07	24.39	19.51	36.59
Bohicon	5.71	0.00	54.29	37.14	2.86
Porto-Novo	11.43	5.71	31.43	34.29	17.14
Abomey-Calavi	36.84	0.00	15.79	21.05	26.32
Mean	14.11	5.70	31.47	28.00	20.73
Head of kitchen					
Comè	21.95	7.32	34.15	19.51	17.07
Bohicon	37.14	0.00	40.00	22.86	0.00
Porto-Novo	31.43	0.00	31.43	28.57	8.57
Abomey-Calavi	21.05	0.00	34.21	28.95	15.79
Mean	27.89	1.83	34.95	24.97	10.36

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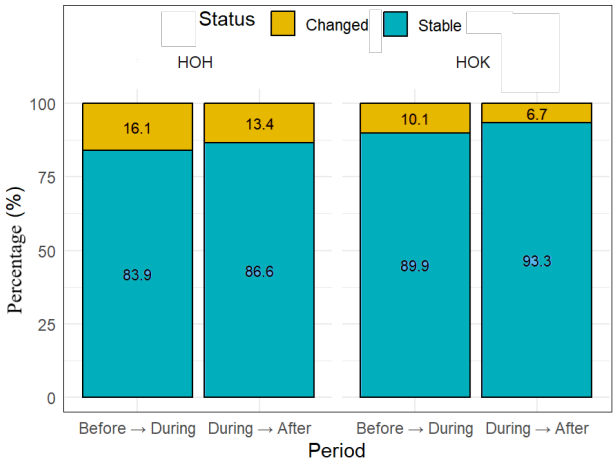

Fig. 2: *Changes in income sources between COVID-19 periods.*

3.2 *Impact of COVID-19 on dietary diversity of urban households*

Regardless of the city status or the type of household member, the overall dietary diversity of urban households did not vary significantly ($p > 0.05$) during the three periods of the first wave of COVID-19 for the two years (2019 and 2020) of observations (Figure 3). However, a significant difference ($p < 0.05$) was observed in the dietary diversity of HOH between the two years for urban households located inside the SC. This significant difference of IDDS for HOH was observed during the period of the higher rates of contamination and the establishment of the SC. During this period in 2020 and compared to the same period in 2019, the dietary diversity of HOH decreased drastically in the cities located inside the SC, with an IDDS that decreased from 8.51 to 7.49, indicating a decline of 11.88 % (Figure 3). This decrease of dietary diversity was much greater than that observed in the cities located outside the SC, with an IDDS that decreased from 7.46 to 7.12, indicating a decline of 4.69 %. A decrease of dietary diversity (but not significant) was also observed for HOK during this same period of higher rates of contamination in 2020, with declines of the IDDS of 7.23 % and 5.26 %, respectively, inside and outside the SC. For children under five years old during the same period of higher contamination, a non-significant increase of IDDS was observed from 7.31 in 2019 to 7.51 in 2020 inside the SC (an

increase of 2.73 %), and a non-significant decrease of IDDS from 7.14 in 2019 to 6.71 in 2020 was observed outside the SC (a decline of 6.02 %) (Figure 3).

However, during the exit from this period of higher rates of contamination during the pandemic in 2020, the dietary diversity of HOH, HOK, and children decreased (not significantly) both inside and outside the SC, compared to the same period in 2019 (Figure 3).

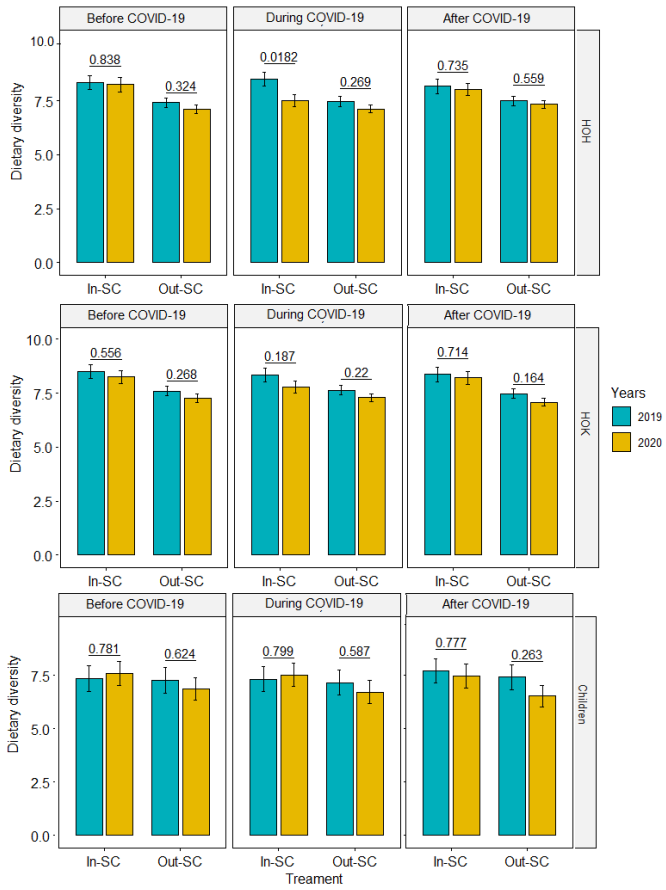

Fig. 3: *Mean Individual Dietary Diversity Score (IDDS) for HOH, HOK, and children under five years old for the three periods in 2019 and 2020. (In-SC, inside the sanitary cordon; Out-SC, outside the sanitary cordon; HOK, head of household; HOK, head of kitchen.)*

The robustness of the linear regression model is evidenced by its high overall statistical significance ($F = 26.12$, $p < 2.2e\text{-}16$), demonstrating that it accounts for a meaningful proportion of the variability in individual dietary diversity scores (IDDS). The adjusted R^2 of 0.3224 indicates that approximately 32 % of the observed variation in IDDS is attributable to the model's explanatory variables. Linear regression models showed that city status, year, type of household member, education level, ethnic group, and gender were factors with significant effects ($p < 0.05$) on IDDS (Table 4). However, period, socio-demographic characteristics, and the interactions between different factors had non-significant effects ($p > 0.05$) on IDDS.

The variability in dietary diversity before, during, and after the first wave of the pandemic was characterised by a readjustment of the composition of household diets. For the three periods of observation from 2019 and 2020, non-significant differences ($p > 0.05$) were noted during the pandemic between the CR of food groups consumed by urban households inside and outside the SC except for meat (see annex 1). The CR of meat for urban households inside the SC was significantly different ($p = 0.05$) from that of urban households outside the SC between the two years (see annex 1). Indeed, in 2019, the CR of meat for urban households inside the SC was greater than that of households outside the SC. However, during the COVID-19 pandemic in 2020, the CR of meat for urban households inside the SC was less than that of households outside the SC.

3.3 Impact of COVID-19 on income of urban households

Income varied across household roles and pandemic periods. Apart from education level and household role, no other variables significantly affected overall household income, and these detailed ANOVA results are therefore not discussed further. As shown in Figure 4, income declined most sharply during the early phase of the pandemic, with total household income experiencing the largest reductions. Kitchen managers (HOK) demonstrated greater financial resilience than household heads (HOH), showing smaller losses and clearer recovery in the post-pandemic period. Geographic differences were modest, although households inside the sanitary cordon experienced slightly greater income declines. Overall, the findings indicate a pronounced initial income shock followed by partial recovery, with household role emerging as the main source of heterogeneity.

3.4 Coping strategies for food security during the COVID-19 by urban households

Generally, households used several coping strategies to deal with periods of financial difficulties and food shortages. Figure 5 shows a pronounced rise in the reduced Coping Strategy Index (rCSI) during the pandemic, with households inside the sanitary cordon experiencing the steepest increases, in some cases reaching up to fourteen times their 2019 levels. Although rCSI remained higher than pre-pandemic values after restrictions were lifted, the gradual decline observed suggests the beginning of recovery. These findings highlight a substantial escalation in coping pressure during the restriction period, particularly for households facing mobility constraints, and justify focusing on the most

Table 4: *Results of the linear model showing the effects of year, city status, period, type of household member, socio-demographic characteristics, and their interactions on IDDS. (Details of estimates are shown in Table S1, supplementary file.)*

Source of variation	*DF**	*Sum of squares*	*Mean square*	*Fisher statistic*	*P-value*
City status	1	231.3	231.335	55.25	< 0.001
Year	1	58.8	58.841	14.05	< 0.001
Period	2	6.2	3.076	0.73	0.479
Type of household member	2	35.0	17.495	4.18	0.015
Education level	4	328.9	82.232	19.64	< 0.001
Ethnic groups	25	3767.3	150.691	35.99	< 0.001
Gender	1	19.2	19.249	4.59	0.032
City status: Year (DID)	1	1.2	1.185	0.28	0.595
Period: City status: Year	2	18.2	9.113	2.18	0.114
Type of household member: City status: Year	2	18.0	8.978	2.14	0.117
Multiple R-squared: 0.3352					
Adjusted R-squared: 0.3224					
F-statistic: 26.12 on 41 and 2124 DF					
P-value: $< 2.2e-16$					

*DF = Degrees of freedom

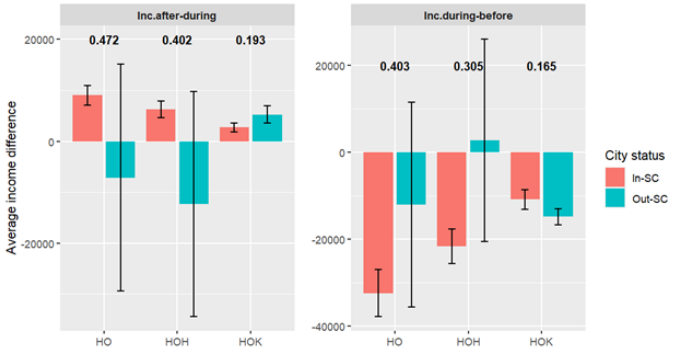

Fig. 4: *Differences in monthly incomes between the periods during and before the pandemic (Inc.during - Inc.before) and the periods after and during the pandemic (Inc.after - Inc.during): between HOK, HOH and HO. (In-SC: inside the sanitary cordon; Out-SC, outside the sanitary cordon; HOK, head of household; HOK, head of kitchen., HO: Household)*

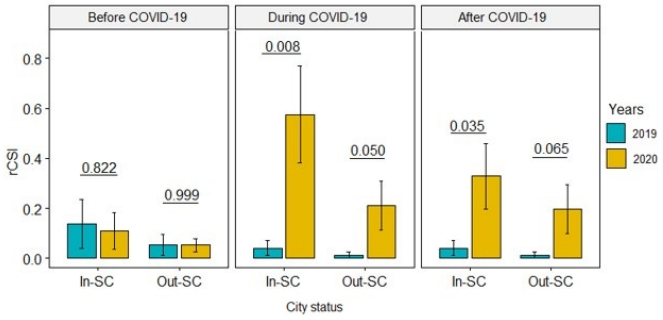

Fig. 5: *Mean reduced coping strategy index (rCSI) of households according to period, year, and city status. (In-SC, inside the sanitary cordon; Out-SC, outside the sanitary cordon.)*

Table 5: *Effects of the year, city status, and their interaction on the reduced coping strategy index.*

Source of variation	*DF*	*Sum of squares*	*Mean square*	*Fisher statistic*	*P-value*
City status	1	2.98	2.9838	5.21	0.023
Year	1	8.47	8.4664	14.80	< 0.001
City status : Year	1	1.06	1.0582	1.85	0.174

salient trends rather than repeating detailed values or statistical outputs.

Regression analysis confirmed that both year and city status significantly influenced the reduced Coping Strategy Index (rCSI), whereas their interaction was not significant (Table 5). This indicates that coping pressure increased during the pandemic and was systematically higher for households inside the sanitary cordon, but the effect of the sanitary cordon did not vary across periods. The table therefore highlights consistent differences between years and locations rather than complex interaction patterns, supporting the interpretation that mobility restrictions heightened coping stress independently of temporal dynamics.

The coping strategies used by the households indicated in table 6 were mainly relied on three coping strategies: spending savings, borrowing money, and reducing non-food expenditure. Less frequently, some households resorted to selling livestock or temporarily withdrawing children from school, while the sale of household assets, land, or relying on begging were virtually absent. The few cases of school

withdrawal occurred after schools had officially reopened, reflecting financial pressure rather than closures. For some less vulnerable households, keeping children in school may have acted as a protective strategy, particularly where school canteens were available.

During the pandemic, spending savings and reducing non-food expenditure were the most common responses, while borrowing became more prominent afterwards. Chi-square tests showed no significant differences in the use of the main coping strategies by city status, year, or period, suggesting similar behavioural patterns across groups.

Table 6: *Coping strategies used by urban households.*

Rank	*Coping strategy*	*Proportion (%)*
1	Spending savings	40.83
2	Borrowing money	23.04
3	Reducing non-food expenditure	16.89
4	Sale of livestock	2.56
5	Withdrawing children from school	0.67
6	Sale of household assets and goods	0.22
7	Sale of lands	0.00
8	Begging	0.00

4 Discussion

The results of this study confirm that the COVID-19 pandemic had measurable effects on dietary diversity, income, and coping behaviour among urban households in Benin, consistent with patterns observed in other low- and middle-income countries (Headey & Ruel, 2020; Kansiime *et al*., 2021; Shupler *et al*., 2021). The decline in dietary diversity during the restriction period reflects reduced market access and purchasing power, a mechanism widely documented during the pandemic as mobility restrictions disrupted informal food systems (HLPE, 2020; Torero, 2020).

Household role emerged as a key factor influencing both dietary and income outcomes. Kitchen managers showed greater adaptability during the crisis, which aligns with evidence that individuals responsible for daily food procurement often adjust strategies more rapidly under constraint (Gebru *et al*., 2021). The more pronounced income decline among household heads mirrors observations from other African contexts where informal sector workers experienced immediate earnings losses (ILO, 2020; Chabossou *et al*., 2022). The slightly greater losses among households inside the sanitary cordon suggest that mobility-based containment measures contributed to tightening economic pressure, as reported in similar urban settings under movement restrictions (Subramanian *et al*., 2022).

The strong increase in the reduced Coping Strategy Index (rCSI) further indicates heightened financial stress, particularly in areas subject to stricter controls. This trend is consistent with findings that households adopted a wider range of consumption-related strategies during the pandemic, prioritising adjustments that avoided asset depletion (Maxwell and Caldwell, 2008; Amare *et al*., 2021). The decline in rCSI after restrictions were lifted suggests progressive recovery, although values remained above pre-pandemic levels, indicating lingering vulnerability.

Overall, the evidence shows that COVID-19 amplified pre-existing fragilities in urban food systems in Benin, particularly in contexts where households depend on informal markets and daily income flows. As highlighted by FAO (2020) and Laborde *et al*. (2020), strengthening social protection, stabilising market access, and supporting informal-sector livelihoods are essential to improving resilience during future shocks. The differentiated impacts observed in this study underline the need for targeted interventions that take household roles and mobility constraints into account.

5 Conclusion

The COVID-19 crisis exposed significant vulnerabilities in the livelihoods of urban households in Benin, particularly within the sanitary cordon where movement restrictions severely disrupted food systems. This study highlights that while the pandemic caused immediate declines in household income and dietary diversity, urban families demonstrated remarkable resilience. By the end of the first wave, households had largely adapted, primarily through coping strategies such as spending savings and borrowing money.

However, this resilience is fragile. The reliance on financial reserves and debt to maintain food security underscores the precarious nature of urban livelihoods during external shocks. The differential impact observed between household heads and kitchen managers further emphasises the need for gender-sensitive policy responses that account for intra-household dynamics.

To ensure long-term food security against future crises, interventions must move beyond temporary relief to structural strengthening of the food system. Policies should prioritise the development of urban and peri-urban agriculture. Specifically, local governments should integrate community, rooftop, and backyard gardening into municipal planning. Supporting vulnerable groups particularly women and youth with access to inputs (seeds, compost) and microfinance programmes will be crucial. By fostering inclusive food policies

and local production, Benin can transform its urban food systems to be more robust and self-reliant.

Supplement

Supplementary information is accessible via the article's DOI: https://doi.org/10.17170/kobra-2026011411803 .

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

The study was conducted in accordance with ethical standards for research involving human participants. Prior to data collection, informed consent was obtained from all participants, and confidentiality and anonymity were strictly respected throughout the research process.

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