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Abstract: Bosnia and Herzegovina has responded to the COVID-19 pandemic by implementing quarantine and other social distancing measures. These measures, however, have mental, social, and economic consequences on diet and food behaviors. The Bosnian case is particularly pertinent since the country has one of the highest global mortality rates relative to its population. In addition, its health system is fragmented and under-resourced. Consequently, in this study, we analyze the effects of the COVID-19 pandemic on Bosnians' behaviors relating to food. It is based on an online survey performed during October–November 2020 with 3133 adult respondents. The statistical analysis encompassed descriptive statistics (means, percentages, and frequencies), as well as cluster analysis. The results reveal that the pandemic transformed consumers' shopping behaviors and food sourcing, reducing shopping frequency and increasing food bought on each trip. Furthermore, there was an increase in the consumption of local food items due to food safety concerns. Additionally, the pandemic improved the awareness of Bosnians towards food with a decrease in food waste. Regarding diets, Bosnians tried to have healthier diets during the pandemic. Therefore, COVID-19 might have opened a 'window of opportunity' to promote the shift towards more sustainable food consumption and lifestyles.

Keywords: COVID-19; diet; food behavior; food shopping; food waste; Bosnia and Herzegovina; Balkans

1. Introduction

On 5 March 2020, Bosnia and Herzegovina (BIH) announced its first case of COVID-19, which was the same day a state of emergency was implemented. On 21 March 2020, the country recorded its first COVID-19 fatality [1]. As of 18 June 2021, confirmed cases reached 204,791 with 179,858 recoveries and 9626 total deaths [2]. The Bosnian case is especially pertinent since it has one of the highest global mortality rates relative to its population. Indeed, with a small population of 3.5 million people and an average of 2910.63 deaths/million, BIH had the third most losses due to COVID-19 globally [3].

In addition, Bosnia and Herzegovina's health system, according to the World Health Organization, is fragmented and under-resourced [4]. The COVID-19 pandemic evolution in BIH can be divided into four waves: the first in the spring of 2020, the second in the summer of 2020, the third in the fall of 2020, and the fourth during the spring 2021 [3]. During these waves, the Bosnian government (cf. entities of the Federation of Bosnia and Herzegovina, the Republic of Srpska, and Brcko district) applied various measures to halt the spread of COVID-19 (e.g., bans entrance for all foreigners, 14-day mandatory quarantine, restricting movement and gatherings, curfew, closing of kindergartens and schools, closing of restaurants, cafes, and non-food stores, wearing of facemasks, remote work, etc.) [5]. However, overall, the health system in Bosnia and Herzegovina lacked a coordinated and proactive response to the crisis [4].

In addition to the impact on human health, COVID-19 has had negative consequences on the BIH economy. BIH is considered to be a developing country with a gross domestic product (GDP) per capita of about 4866 EUR, 31% of the European Union (EU) average. The economy is driven by manufacturing and agriculture, followed by tourism and service sectors [6]. According to the World Bank [7], the pandemic is the greatest significant threat to the BIH economy since the Great Recession of 2008–2009. It predicts that BIH will face the worst economic recession in 25 years, with significant challenges. According to Čavalić et al. [8], BIH, *ceteris paribus*, will undergo a fall in GDP from 3.97 to 9.53% in 2020. The worst-case scenario estimates that the number of unemployed will increase by 96,767 by the end of the year. Solving persistent unemployment and reducing layoffs in the private sector will be a significant challenge during and after the crisis [7]. According to OECD (2020), BIH GDP is estimated to fall by 5% during 2020. The Agency for Statistics of Bosnia and Herzegovina [9] announced that the GDP would fall by 9.3% during the second quarter of 2020.

Although the containment measures were crucial to combat the pandemic, they may have contributed to a disturbance of daily food-related behaviors. The COVID-19 epidemic and related measures substantially impacted daily food patterns, diet, and food-purchase behavior [10–13]. Some of these changes also apply to shifting consumer shopping habits, such as fewer shopping visits, stockpiling, online shopping, etc. [14–19], and consumption [20–22], as well as food waste [12,23].

Food research and the food business face many difficulties due to the COVID-19 pandemic, necessitating studying various food concerns in various countries [24,25]. Food consumption research in Bosnia and Herzegovina will add to a global understanding of people's eating habits during the pandemic. Therefore, in this study, we targeted the evolution of the dietary options and variations in consumption during the COVID-19 pandemic in Bosnian households. This study addresses two questions: (1) How did the COVID-19 pandemic impact food consumption and diets in Bosnia and Herzegovina? and (2) How has the pandemic impacted food purchasing in Bosnia and Herzegovina? To the best of our knowledge, this is the first study that examines the pandemic's direct effects on food purchasing, nutrition, and consumption habits in Bosnia and Herzegovina. We explain the methodology before presenting and discussing the research results.

2. Methods

This study was conducted as part of an international research project entitled "Consumer Agency, Food Consumption Behavior, and Novel Coronavirus (COVID-19) Outbreak," which was sponsored by Western Michigan University's Food Industry Research and Education Center (FIRE) [26]. The study is based on an online questionnaire performed via Survey Monkey in Bosnia and Herzegovina from 15 October to 16 November 2020 (during the third wave of COVID-19). The link to the survey was sent through email and social media (e.g., Instagram and Twitter). The survey utilized the snowball sampling technique, and participants were invited to disseminate the online survey to their friends and family. The non-probability sampling technique was employed; the study's participants volunteered to take part. Each responder was informed of the study's objectives and

context before signing a digital informed consent form covering privacy and information management rules.

The questionnaire consisted of 25 different questions (multiple-choice and one option), split into three sections. The first section included questions about the sociodemographic characteristics of the respondents, such as education level, gender, income, etc. The second section sought information about food purchase and consumption behavior during the COVID-19 pandemic, such as food shopping frequency, including panic buying and stockpiling, diet, concerns during grocery store trips, food waste, etc. Finally, the third section included questions about the positive (e.g., calm, optimistic, and excited) and negative (e.g., sad, bored, and scared) emotions during the pandemic. The questionnaire was tested in two stages before delivery. First, an expert panel conducted a qualitative substance validity analysis to improve the study's validity and reliability. Irrelevant items were omitted based on experts' views, and the remaining items were modified to make them more factual and straightforward. Second, a pretest of 33 participants was conducted to ensure data accuracy, and the input was used to refine the survey questionnaire before its administration. The total of valid collected answers was 3133.

SPSS (Statistical Package for Social Sciences) version 25.0 was used to analyze the survey results. Descriptive statistics (means, standard deviations, percentages, and frequencies) were generated. An examination of multiple responses calculated the percentages of answers and instances. Cluster analysis based on K-means clustering was used to classify variables such as shopping duration and shopping place. The clusters in this study are non-hierarchical, do not overlap, and always include at least one item. K-means clustering attempts to split a collection of n observations (x_1, x_2, \dots, x_n) , into k ($\leq n$) sets, i.e., $S = \{S_1, S_2, \dots, S_k\}$, to minimize the within-cluster sum of squares.

3. Results

The survey findings show that the COVID-19 pandemic has impacted diet and food shopping, preparation, and use/consumption in Bosnia and Herzegovina. We begin by introducing the survey participants' socio-demographic characteristics (Section 3.1) and then examine the impact of the pandemic on diet (Section 3.2) and food-related activities (Section 3.3).

3.1. Sociodemographic Characteristics of the Study Participants

The findings reveal that 70.2% of respondents are women, 78% live in urban areas or cities, 45% live with parents, 49.3% are in paid work, and 60.4% receive the same income as any other Bosnian household. Much of the respondents were middle-aged (48.7% were between 25 and 44 years of age) and 83.94% were highly educated (Table 1).

The study participants' sociodemographic characteristics reveal a sample bias, and not every subgroup is represented proportionately. For example, urban participants were overrepresented in our sample. However, in 2019, with 51% of the population living in rural areas, Bosnia and Herzegovina remain rural [27]. Women and educated people were overrepresented. Accordingly, generalizing the survey findings to the whole Bosnian population is challenging, which is a clear limitation of the present study.

Table 1. Sociodemographic characteristics of the survey participants ($n = 3133$).

| Variable | | Frequency | Percent |
|--|--|-----------|---------|
| Gender | Male | 934 | 29.81 |
| | Female | 2199 | 70.2 |
| | Total | 3133 | 100 |
| Living location | Urban region or city | 2443 | 78 |
| | Rural area or village | 690 | 22 |
| | Total | 3133 | 100 |
| Level of education | No formal schooling/below secondary school level | 16 | 0.5 |
| | Secondary school | 487 | 15.5 |
| | University degree | 1956 | 62.4 |
| | Higher degree (MSc or Ph.D.) | 674 | 21.5 |
| | Total | 3133 | 100 |
| Income level in comparison to other families | Lower | 303 | 9.6 |
| | About the same | 1893 | 60.4 |
| | Higher | 937 | 30 |
| | Total | 3133 | 100 |
| Occupation | In paid work | 1545 | 49.3 |
| | Student | 1276 | 40.7 |
| | Unemployed/looking for work | 263 | 8.4 |
| | Home duties | 35 | 1.1 |
| | Retired/Age pensioner | 14 | 0.4 |
| | Total | 3133 | 100 |
| Household composition | Single | 189 | 6.0 |
| | Living with parents | 1410 | 45.0 |
| | Married with children | 814 | 26.0 |
| | Married without children | 294 | 9.4 |
| | Extended family | 338 | 10.8 |
| | Shared household, non-related | 88 | 2.8 |
| Total | 3133 | 100 | |
| Age | 18–25 | 1225 | 39.1 |
| | 25–44 | 1525 | 48.7 |
| | 45–55 | 253 | 8.1 |
| | >55 | 130 | 4.1 |
| | Total | 3133 | 100 |
| Job loss/pay reduction | Yes | 318 | 10.2 |
| | No | 2815 | 89.8 |
| | Total | 3133 | 100 |

3.2. Food Consumption and Diets during the COVID-19 Pandemic

The findings indicate that consumers' diets changed during the COVID-19 pandemic in Bosnia (Figure 1). Indeed, 25.66% of the participants ate more healthy foods, 27.83% ate more fruits and vegetables, while 22.08% drank more water (including both "much more" and "moderately more" answer options). Simultaneously, meat consumption remains stable since most survey participants (86.37%) did not change their meat consumption habits. Furthermore, 33.22% of the cohort reported eating less unhealthy meals (e.g., fast food), 24% fewer unhealthy snacks, and 19% fewer sweets, cookies, cakes, and candies (all numbers include "much less" and "slightly less" response choices).

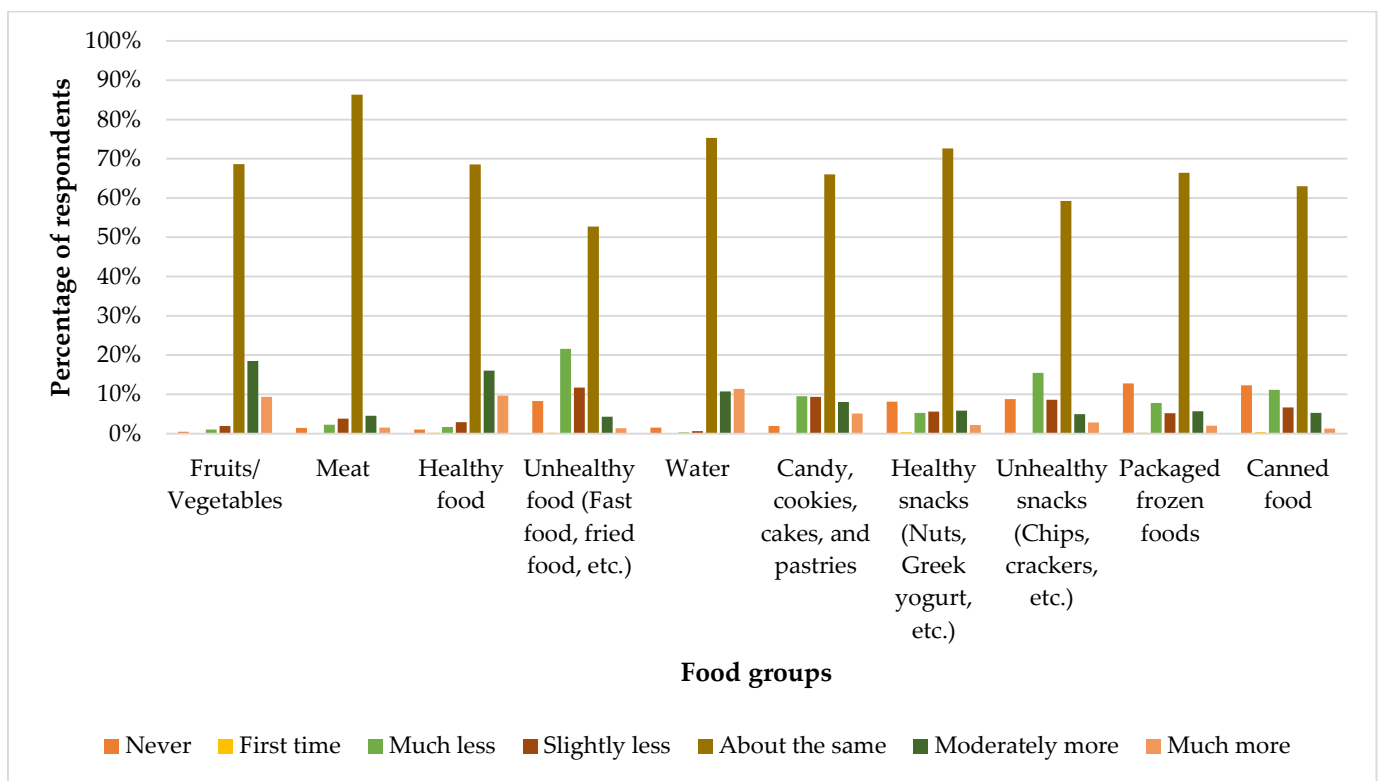


Figure 1. Changes in food consumption and diets during the COVID-19 pandemic in Bosnia ($n = 3133$). Scale: never = 0; Figure 1. much less = 2; slightly less = 3; about the same = 4; moderately more = 5; much more = 6.

3.3. Food Activities and Food Shopping Habits during the COVID-19 Pandemic

In terms of shopping behavior, as indicated in Figure 2, 33% of the respondents reported making fewer grocery-shopping visits than usual during the pandemic, while 64.09% of the respondents shopped as they used to, and only 2.9% of the respondents went shopping more than usual. Regarding the changes in the scope of purchases since the outbreak of COVID-19, 12.67% of the cohort reported purchasing more and a lot more than usual on each trip (encompassing “a lot more” and “more” response choices). In addition, 9.28% of the cohort indicated that they buy less or a lot less than usual. However, 78.04% said they did not alter their behavior and continued to buy as usual.

Table 2 also shows some shifts in food-related activities. By adding “moderately more” and “much more”, 15.8% of the cohort indicated that they buy more local food, 27.32% are eating more with family members, 40.66% are cooking and preparing meals considerably more often, and 37.7% are spending a lot of time cooking. In the meantime, 56.91% of the cohort ate out less (e.g., restaurants/cafeteria/fast food), 49.28% ate less at someone else’s place, and 29.46% ordered less take-away or fast food meals, with deliveries (all by including “slightly less” and “much less”).

Food-use habits and attitudes have also changed, especially regarding household food wastage. Many of the respondents reported throwing away less food after the COVID-19 outbreak, 95.85% of the cohort stated that they did not waste more food than usual, and 31.8% said their food waste had decreased. Furthermore, 62.72% of the respondents stated that they are more conscious of how much food they discard (Figure 3).

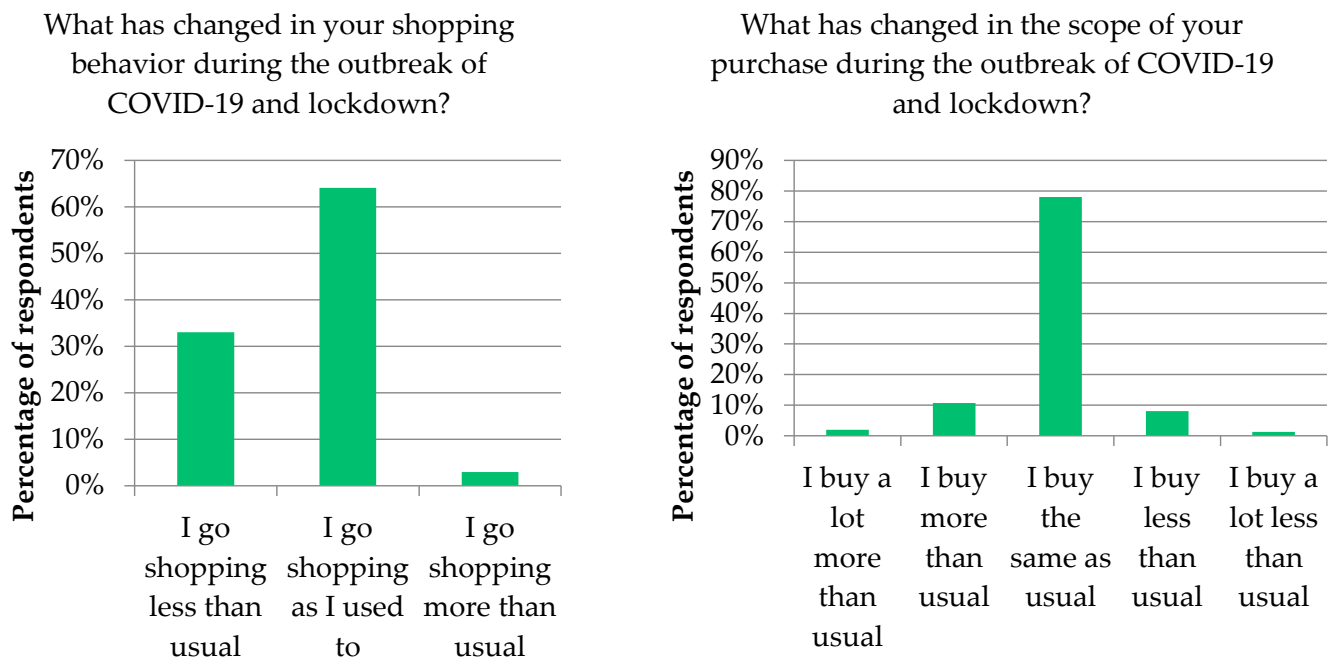


Figure 2. Shopping habits changes during the COVID-19 pandemic ($n = 3133$). Scale: I buy a lot more than usual = 5; I buy more than usual = 4; I buy the same as usual = 3; I buy less than usual = 2; I buy a lot less than usual = 1.

Table 2. Changes in food-related activities during the COVID-19 pandemic ($n = 3133$).

| Scale Item | Percentage of Respondents * | | | | | | | Total | Weighted Average |
|---|-----------------------------|------------|-----------|---------------|----------------|-----------------|-----------|-------|------------------|
| | Never | First Time | Much Less | Slightly Less | About the Same | Moderately More | Much More | | |
| Buying local food | 2.30 | 0.67 | 1.40 | 2.68 | 77.15 | 9.10 | 6.70 | 100 | 4.01 |
| "Eating at home alone" | 6.70 | 0.16 | 5.81 | 3.10 | 69.45 | 6.64 | 8.14 | 100 | 4.28 |
| "Eating with family members" | 0.73 | 0.10 | 1.82 | 2.27 | 67.76 | 10.05 | 17.27 | 100 | 4.41 |
| "Eating out (e.g., restaurants/cafeteria/fast food)" | 11.24 | 0.03 | 43.12 | 13.79 | 29.68 | 1.72 | 0.41 | 100 | 3.36 |
| Eating at someone else's place" | 10.85 | 0.13 | 36.39 | 12.89 | 37.38 | 1.60 | 0.77 | 100 | 3.5 |
| "Ordering take-away or fast food meals with deliveries" | 21.93 | 0.38 | 20.65 | 8.81 | 40.76 | 5.90 | 1.56 | 100 | 4.24 |
| "Cooking and preparing food" | 1.05 | 0.13 | 0.64 | 0.73 | 56.78 | 17.30 | 23.36 | 100 | 4.65 |
| "Spending a lot of time cooking" | 2.17 | 0.19 | 1.40 | 1.34 | 57.20 | 19.28 | 18.42 | 100 | 4.58 |

* Scale: never = 0; first time = 1; much less = 2; slightly less = 3; about the same = 4; moderately more = 5; much more = 6.

The cluster analysis to classify the respondents yielded two different clusters (Table 3). The first cluster encompasses 68% of the respondents ($n = 2139$) who did not change their behavior and shopped as they used to during the pandemic; most (82.2%) respondents bought the same food as usual and stocked less food than those in the second cluster. Consequently, food waste has not changed for 97.3% of them. The second cluster encompasses 32% of the respondents ($n = 994$), who went shopping less than usual (45.7%) and stocked more food than the first cluster. Consequently, they wasted more food.

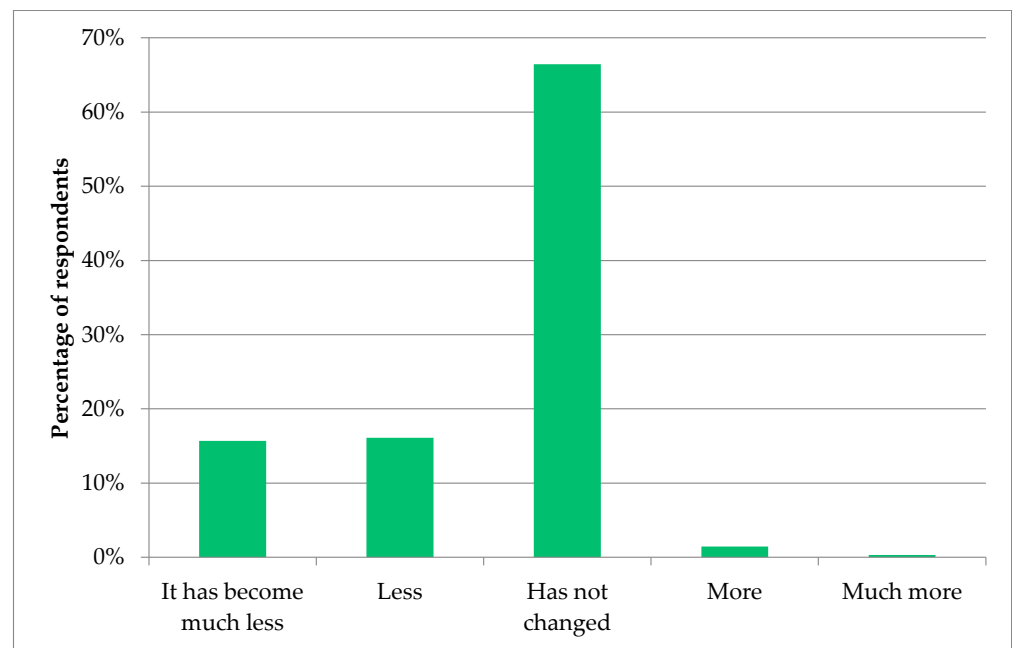


Figure 3. Change in household food wastage during the COVID-19 pandemic ($n = 3133$).

Table 3. Cluster analysis ($n = 3133$).

| Variable | Percent | |
|--|-----------------------------|----------------------------|
| | Cluster 1 ($n = 2139$) | Cluster 2 ($n = 994$) |
| What has happened in the frequency of your purchases since the COVID-19 outbreak? | | |
| I go shopping less than usual | 27.1 | 45.7 |
| I go shopping like I used to | 70.5 | 50.2 |
| I go shopping more than usual | 2.3 | 4.1 |
| Total (%) | 100 | 100 |
| What has changed in the scope of your purchases since the emergence of COVID-19? | | |
| I buy a lot less than usual | 0.7 | 2.3 |
| I buy less than usual | 5.9 | 12.6 |
| I buy as same as usual | 82.2 | 69 |
| I buy more than usual | 9.6 | 13.1 |
| I buy a lot more than usual | 1.4 | 3.0 |
| Total (%) | 100 | 100 |
| Because of the coronavirus (COVID-19), have you stockpiled on food and beverages? | | |
| Yes | 30.2 | 46.6 |
| No | 69.8 | 54.0 |
| Total (%) | 100 | 100 |
| How has your food waste changed after the COVID-19 outbreak? | | |
| It has become much less | 0.00 | 0.00 |
| Less | 0.1 | 0.00 |
| Has not changed | 97.3 | 49.5 |
| More | 2.1 | 50.5 |
| Much More | 0.5 | 0.00 |
| Total (%) | 100 | 100 |

Table 3. Cont.

| Variable | Percent | |
|--|-------------------------|------------------------|
| | Cluster 1 (n = 2139) | Cluster 2 (n = 994) |
| Do you eat more food out of fear, anxiety or boredom? | | |
| Yes | 14.1 | 21.0 |
| No | 85.9 | 79.0 |
| Total (%) | 100 | 100 |
| Do you buy more food out of fear or anxiety? | | |
| Yes | 9.4 | 18.6 |
| No | 90.6 | 81.4 |
| Total (%) | 100 | 100 |
| Are you wasting more food than usual? | | |
| Yes | 5.0 | 2.4 |
| No | 95.0 | 97.6 |
| Total (%) | 100 | 100 |
| Are you more aware of how much food you waste? | | |
| Yes | 55.7 | 77.8 |
| No | 44.3 | 22.2 |
| Total (%) | 100 | 100 |

4. Discussion and Conclusions

This study explores the impact of the COVID-19 pandemic on food dynamics in Bosnia and Herzegovina. Due to the COVID-19 outbreak, food shopping, preparation/cooking, use/consumption, and wastage behaviors have been impaired. The findings revealed several consumer trends in Bosnia and Herzegovina that affect diet and eating behaviors.

Firstly, as demonstrated in numerous European countries such as Russia [19], Serbia [28], the Czech Republic [29], and the overall Western Balkans (WB) region [30], COVID-19 has affected consumers' purchasing behaviors and food procurement. Because shopping in a supermarket is viewed as a challenge (fear of the virus, fear of being near others, long waiting lines in supermarkets, etc.), participants' purchasing behaviors have also changed. Indeed, most of them reduced the number of shopping visits and shopped less than usual, buying more during each visit to reduce the number of store visits and lower their apparent risk of contact with the virus. However, as indicated by the cluster analysis, some respondents did not alter their behavior and continued shopping as usual.

Second, the findings indicate a trend towards healthier diets. Indeed, some respondents decreased their intake of unhealthy foods (e.g., sweets, desserts, cookies, and pastries) during the pandemic. In the meantime, they adopted healthier eating habits, including consuming more fruits and vegetables. As noted in many countries, this trend was undoubtedly motivated by healthier dietary considerations due to greater prominence of health and wellness in customers' minds. Indeed, after the outbreak, many consumers prioritized their health by eating healthier foods to strengthen their immune systems [31]. This can represent an important step forward in meeting the goal of reducing the incidence of diet-related non-communicable diseases (NCDs). Recently, Bosnia and Herzegovina has made little progress towards meeting the target for obesity, with 18.4% of adult women and 17.1% of adult males being obese. However, the country's obesity rate is lower than the regional level of 23.3% for women and 22.2% for men [32].

Third, due to food safety concerns, consumption of local food items has risen. Several factors could also explain this change. Amid a health crisis, the most critical concern for consumers is to eat healthy, nutritious, and safe food. With the COVID-19 outbreak, there was ambiguity about the virus's transmission, and people were more interested in knowing where their food originated from. Unfounded consumer assumptions that imported food products may represent a safety concern resulted in a preference for locally produced foods [33]. Moreover, local food items are perceived as more nutritious and

fresh than the imported ones, with greater immunity-boosting qualities [34]. However, local food consumption depends on its availability, as BIH relies heavily on imports for its food supply [35]. In 2019, the total rate of imports/export coverage was 58.9% and only 23.2% for food items [36]. The country remains dependent on food imports due to low self-sufficiency in most key food items, which indicates its vulnerability to possible disruptions in global food supply chains and foreign trade. However, there were no significant food shortages during the lockdown in BIH because shops (operated with reduced hours, but still every day) were supplied with sufficient quantities of food and successfully mitigated increased shopping due to population panic over possible shortages. Moreover, due to increased demand, price increases and speculation were expected, which was prevented by introducing administrative control of food prices by limiting trade margins. Fearing possible food shortages, farmers reacted responsibly and sowed about 6.6% more land in the spring season than in the previous year [37]. The agro-climatic conditions in 2020 were also favorable; hence, grain yields were above the multi-year averages. Therefore, despite the pandemic, the domestic market's supply was not endangered [38].

Fourth, there was an increase in home cooking, a reduction in the consumption of prepackaged and ready-to-eat meals, as well as a move towards dining at appropriate meal times and with other family members. Furthermore, some consumers moved from out-of-home to in-home dining, with more cooking and baking done at home. As observed in Qatar [39] and Lebanon [40], with the closure of restaurants, coffee shops, and cultural institutions during the lockdown, entertainment choices became limited, and dining with family and cooking became new amusing pastimes.

Fifth, food-use habits and attitudes also changed. The survey outcomes suggest a decrease in food waste. This change could mean that, during the pandemic, consumers have implemented an extensive range of effective food management tactics, such as more innovative food shopping plans, better in-house food storage, and higher usage of leftovers. This indicates an interesting trend towards more sustainable food consumption behavior. Knowing that food waste is one of the leading waste streams in Bosnia and Herzegovina, and the volume of waste produced has continued to increase over the last few years, this constitutes a positive change. Before the COVID-19 pandemic, every day, almost 500 tons of food waste ended up in landfills. Food waste accounts for more than 12% of daily waste disposal at the landfill in Canton Sarajevo [41].

Finally, as highlighted above, the sample bias is the main limitation of this research, a common limitation in computer-assisted web interviewing (CAWI), which is regularly used in surveys [42–45]. The study participants were volunteers, not paid, and selected randomly (cf. self-selection of the sample). They participated in the survey only because the subject inspired them. However, because of the COVID-19 outbreak, online surveys may collect data remotely, which is a significant benefit when social distance is needed since face-to-face surveys are complicated and unsafe. Even before the pandemic, the use of online surveys had skyrocketed owing to their low costs and fast turnaround times [45].

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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