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Can an apple a day keep COVID-19 away? A cluster analysis of the long-term COVID-19 pandemic's impact on the consumption of apples in Italy

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Abstract

Purpose – Apples have always been considered a healthy product able to provide curative properties to consumers. In Italy, there is a long tradition of apple consumption and production both as a fresh product and as processed food. However, as with many other products, the consumption of fruits and vegetables and, more specifically apples, has been drastically affected by the first lockdown in 2020. In this project, the authors investigate whether the change in consumption habits had long-lasting consequences beyond 2020 and what are the main eating motivations, food-related behavior and socio-demographic affecting the consumption of fruits and vegetables after the pandemic.

Design/methodology/approach – The authors ran two online surveys with 1,000 Italian consumers across a year (from October 2021 to December 2022). In the study, participants answered questions about their consumption habits and their eating motives. Out of 1,000 consumers, the authors included in the final analysis only the participants who answered both surveys, leaving a final sample of 651 consumers.

Findings – The results show that participants have allocated more budget to fruit and vegetables after the lockdown than before it. Moreover, consumers reported an average increase in the consumption of apples. However, the increase was more pronounced for people aged between 30 and 50 years old and identified as female. After showing the difference across time, a cluster analysis identified three main segments that differ in their eating motives, place of purchase and area of residence.

Practical implications – Overall, the results contribute to a better understanding of how the global pandemic is still affecting people's daily life. Moreover, the findings can be used to guide the marketing and communication strategies of companies in the food sector.

Originality/value – To the best of the authors' knowledge, this is the first study that investigates changes in the consumption of fruits and vegetables, and, more specifically, apples, in Italy more than one year after the beginning of the COVID-19 pandemic. Moreover, the study proposes a classification of consumers based on their habits in a time frame during which the COVID-19 wave was at its bottom which is not currently present in the literature.

Keywords COVID-19, Apples, Health, Consumer segments

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1. Introduction

"An apple a day keeps the doctor away" – a popular proverb.

When the COVID-19 pandemic started in 2020, most of us had no idea that the consequences of such an event would still last nowadays (WHO, 2023). Among many other sectors such as business and education (e.g. Gardner and Matviak, 2020; Korn *et al.*, 2020), the COVID-19 pandemic has significantly impacted consumers' eating habits worldwide (e.g. Ammann *et al.*, 2022; Dumitras *et al.*, 2021; Güney and Sangün, 2021; Sooriyaarachchi *et al.*, 2022). Health and safety concerns have influenced consumer preferences, with an increasing demand for products considered healthy (Caso *et al.*, 2022; Alaimo *et al.*, 2020; Lanfranchi *et al.*, 2017). In particular, fruits and vegetables have been identified as products that can help improve immunity and prevent disease (Alaimo *et al.*, 2022; Mattioli *et al.*, 2020). Among the different fruits and vegetables, the apple has a long tradition to be a fruit associated with a healthy diet and curative properties (Anderson *et al.*, 1994; Gallus *et al.*, 2005; Lanfranchi *et al.*, 2015).

In general, previous literature has investigated different reasons why people are willing to consume apples. For example, people with higher perceived and objective knowledge about apples' characteristics give more importance to the physical attributes of the product, which ultimately, affects consumption (Rombach *et al.*, 2022a). A study conducted with Danish consumers shows that people have different preferences for organic and locally produced apples depending on their beliefs about organic food (Denver and Jensen, 2014). Another study conducted by Kamphuis *et al.* shows that good local availability (e.g. access to one's own vegetable garden, having low food insecurity) seemed to exert a positive influence on intake. Important determinants for the purchase of fruits and vegetables included taste and health awareness/knowledge (Grosso *et al.*, 2013; Hartman *et al.*, 2013). Consumers are also more willing to pay for certified apples (Wang and Huo, 2016), and willing to buy depending on the price, origin, and the type of production (Hurgobin *et al.*, 2020). Moreover, studies have shown that the preferences for apple consumption depend on some demographic characteristics. For example, young people are less likely to consume apples than older generations (Konopacka *et al.*, 2010) and people from some countries are more likely to accept certain varieties of apples over others (Bonany *et al.*, 2013). Some studies conducted with Italians consumers examined the relationship between fruit and vegetable consumption and food-related family lifestyle (dinner with parents, family food rules, and television viewing behaviors) (Verzeletti *et al.*, 2010), and that consumption of fruit is mainly based on credence and experience attributes, which have different effects on the consumer decision to consume fruit (Migliore *et al.*, 2015). The first lockdown in 2020 has drastically affected the consumption of apples in Italy (Maugeri *et al.*, 2023; Bossi Fedrigotti and Fischer, 2020) and in other countries (e.g. Rombach *et al.*, 2022b; Isaskar and Periwitasari, 2021). For example, previous research has shown an overall increase in the consumption of fruits and vegetables of around 18% during the first Italian lockdown (Crea, 2020). Similar trends have been observed in other countries. During the lockdown in Canada, the distribution of fresh food has remained one of the key sectors in the food service and retail industry (Richards and Rickard, 2020). Also in China, people have started consuming healthier options such as fruits, vegetables, and cereals-based products more after the lockdown and consuming fewer alcoholic beverages, snacks, and junk food (Chen *et al.*, 2021; Jia *et al.*, 2021). However, all these studies focus on a very short temporal difference before and after the lockdowns in 2020. Thus, it is not clear whether the changes in consumption habits are long-lasting.

The objective of this paper is twofold. First, we investigate the changes in consumption patterns over one-year time between the Italian lockdown in 2021 and a similar period in 2022. This time frame provides a unique opportunity to study whether it was the first lockdown that affected consumption habits or whether any form of restriction might influence

subsequent habits of consumers more in the long run. In Italy, the apple has always been one of the most consumed fruits (Ceschi *et al.*, 2018). In the '80s, the per capita consumption of apples in Italy was 26.5 kg (ISMEA, 1994). In the following years, the number decreased to reach an average of 20 kg per capita per year in 2019, with most of the apples consumed coming from local producers (Coldiretti, 2019; Assomela, 2022). Moreover, Italy is one of the main producers of apples in Europe, with a yearly production of around four million tons (Murder *et al.*, 2022). The majority of the apples produced in Italy are consumed as fresh products, while a small part is transformed into juices, marmalades, or other derivatives (Coldiretti, 2019).

The second objective of the present paper is to provide a comprehensive overview of how eating motivations, food-related behavior (e.g. where people buy apples from), and socio-demographic influences the money spent on fruit and vegetables and the consumption of apples after two years from the beginning of the pandemic. As such, the study aims to identify clusters of individuals according to eating motivations and to infer how socio-demographics and food-related behaviors may be associated with those clusters. Moreover, we aim at comparing the clusters in terms of consumption habits in the Italian market. Understanding the consumers' motives for shopping behavior is fundamental for companies and policymakers to promote the consumption of fruits and vegetables.

Overall, the study provides both theoretical and practical contributions. The paper contributes to the recent literature about changes in consumption habits due to COVID-19 (e.g. Ammann *et al.*, 2022; Dumitras *et al.*, 2021; Güney and Sangün, 2021; Sooriyaarachchi *et al.*, 2022). In particular, the findings show the long-term effects of the pandemic on consumers' behavior and consumption of fruit and vegetables. Moreover, the study provides practical implications for policymakers and companies operating in the sector. By identifying three clusters of consumers, the paper identifies and describes segments of consumers that could be targeted based on their socio-demographic characteristics and eating motives.

2. Material and methods

2.1 Participants and procedure

As the aim of the study is to test for changes in consumption habits over time, we conducted a longitudinal study asking the same sample of consumers to fill out a questionnaire two times. As such, the data collection was conducted in two separate periods. On December 2021, during one of the Italian lockdowns, 1,000 people were invited to take part in a longitudinal study aimed at evaluating the consumption of apples during the COVID-19 pandemic. Participants were asked to fill out an online self-reported questionnaire on Google Forms in exchange for the chance to win some Amazon vouchers. Like previous studies conducted during COVID-19 restrictions (e.g. Lamy *et al.*, 2022), the recruitment strategy consisted of dissemination of the online survey link through social media (Facebook, LinkedIn, Twitter, WhatsApp), through researchers' network (private and official e-mail contacts), and institutional and media sites. Similar to previous literature (Alaimo *et al.*, 2022), the use of a snowball sample allowed us to get access to the consumers while guaranteeing their security during the pandemic conditions.

Out of 1,000 people, 776 adults electronically signed the informed consent form and filled out the first questionnaire (T1). After one year, starting from December 2022 (when the lockdown was over), we contacted the first group's participants again and asked them to fill out the second questionnaire (T2). In total, 651 participants answered both questionnaires and reported that they were eating/buying apples. We conducted all the statistical analyses with this sample.

2.2 Measures

2.2.1 Sociodemographic questions. In both questionnaires, participants reported their demographic information. In particular, participants indicated their gender, age, number of family members, area of residence in Italy, household income, and occupation.

2.2.2 Apple consumption measures. Our key variables of interest are related to the consumption of fruits and vegetables and, more specifically, of apples before and after the pandemic. Thus, participants answered a question on how much of their budget was allocated to fruit and vegetables on a scale 5 points scale (*0 = 0–20%, 1 = 20–40%, 2 = 40–60%, 3 = 60–80%, 4 = More than 80%*). Moreover, participants rated the weekly frequency of apple consumption on a 3 points scale (*0 = I do not consume apples, 1 = between 1 and 3 days per week, 2 = more than 4 times per week*). Finally, participants reported the number of apples they were purchasing every time they were going shopping on a 4 points scale (*0 = I do not buy apples, 1 = between 1 and 3 apples, 2 = between 4 and 7 apples, 3 = more than 7 apples*). Participants answered these three questions both at times T1 and T2. Participants also reported the place where they were purchasing apples (e.g. supermarkets, KM0, fruit sellers, online).

2.2.3 Consumption motivations. In the survey sent at time T2 (i.e. after the lockdown), participants also answered some questions about the motivations to consume apples. To do so, participants answered some items from the Eating Motivation Survey (TEMS – Renner *et al.*, 2012). In particular, we used four scales from the brief version of the TEMS. The scales were chosen to reflect motivations that were deemed particularly relevant for understanding the changes consumers undertake during the pandemic about the specific product (i.e. apples). Dimensions such as sociability or pleasure were considered not appropriate for the aim of the research. The scales included: Health, Natural Concerns, Price, and Convenience. The items, with the mean, standard deviation, and reliability scores are reported in Table 1.

TEMS sub scales	Items	M	SD	Reliability
Health				α = 0.828
	To maintain a balanced diet	5.32	1.29	
	Because it is healthy	4.96	1.15	
	Because it keeps me in shape (e.g. Energetic, and motivated)	5.30	1.23	
Natural concerns				α = 0.933
	Because it is natural (e.g. Not genetically modified)	4.95	1.20	
	Because it contains no harmful substances (e.g. Pesticides, pollutants, antibiotics)	4.94	1.13	
	Because it is organic	5.19	1.28	
Price				α = 0.985
	Because it is inexpensive	4.47	1.40	
	Because I don't want to spend any more money	4.51	1.38	
	Because it is on sale	4.45	1.45	
Convenience				α = 0.969
	Because it is quick to prepare	4.19	1.20	
	Because it is the most convenient	4.18	1.21	
	Because it is easy to prepare	4.22	1.23	

Source(s): Authors' work

Table 1.
TEMS sub scales

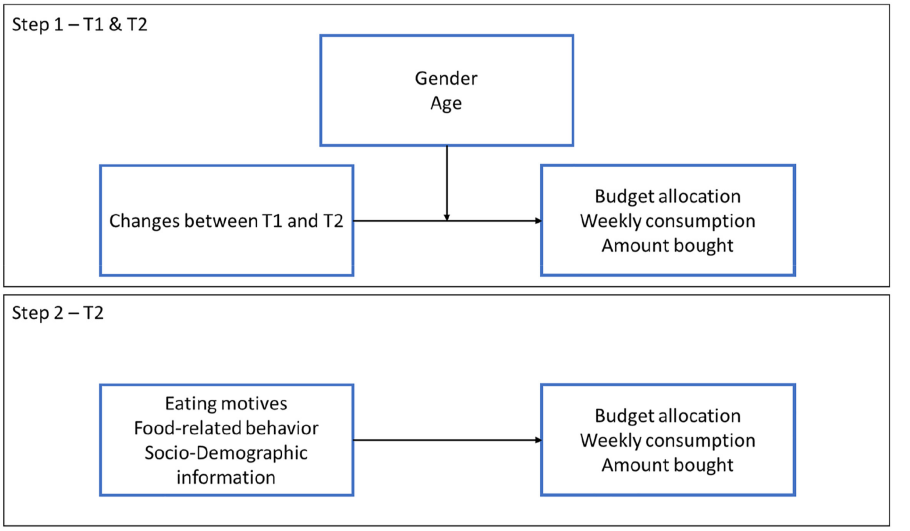
2.3 Statistical analysis

Statistical analysis was performed using SPSS 27.0 software considering an alpha level of 5%. First, we performed a frequency analysis to describe the sample of participants based on the demographic information. The main analysis is divided into two steps.

In the first step, we run a general linear model repeated measures analysis to test for the difference in consumption habits between T1 and T2. First, the analysis was conducted to show the aggregate difference before and after COVID-19. Second, we conducted the same analysis and showed relevant differences based on demographic information (e.g. age and gender).

In the second step, we focused on the consumption behaviors at time T2 and conducted a two-step cluster analysis to distinguish consumer segments (Punj and Stewart, 1983). Average scores for the four eating motives for each of the 651 respondents were used for the cluster analysis.

In the first stage, Ward's hierarchical clustering method with squared Euclidean distances was used to identify clusters. The elbow criterion suggested a 3-cluster solution. In the second stage, a non-hierarchical, k-means clustering procedure (MacQueen, 1965) was used to develop a 3-cluster solution. The final number of clusters was based on the interpretability and reliability of the cluster solution, and the F statistics were also assessed for interpretation purposes. Follow-up analyses were conducted to assess differences between the clusters. In particular, chi-square tests were run to compare the clusters on the demographic information. ANOVA analyses with Bonferroni's adjustment were conducted to compare the clusters on the outcome variables (i.e. budget allocation, weekly frequency, and amount bought per shopping trip). The steps taken to conduct the analysis are summarized in Figure 1.



Note(s): The graph shows the two models computed in the analysis. In Step 1, we compare the differences in consumption behavior before and after the lockdown across gender and age groups. In Step 2, we focus on the period after the lockdown and we investigate how eating motive, food-related behaviors, and socio-demographic affect consumption habits
Source(s): Authors' work

Figure 1.
Steps of the analysis

3. Results

3.1 Demographic characterization of participants

The final sample of 651 participants had the following characteristics: 52% female, mean age = 27.43 (SD = 11.13), 57% living in the South of Italy, 44% student, median income between €7,500 and €15,000, with an average of 3 people in the family (SD = 1.03), and 57% purchasing apples in supermarkets. The complete information about the demographics is reported in Table 2. The characteristics of the sample are similar to the ones of previous literature on the topic (e.g. Ammann *et al.*, 2022).

3.2 Changes in consumption before and after the lockdown

The results show that participants invested significantly more budget in fruits and vegetables after the lockdown (M = 1.13, SD = 1.33) than before (M = 0.63, SD = 0.94; F(1, 596) = 98.807, $p = < 0.001$). Moreover, there has been a significant increase in the weekly frequency of apple consumption between T1 (M = 0.69, SD = 0.77) and T2 (M = 1.47, SD = 0.61; F(1, 650 = 410.006, $p = < 0.001$). Finally, participants also reported that they were buying fewer apples on every shopping trip during the lockdown (M = 2.03, SD = 0.62) than after (M = 2.25, SD = 0.63; F(1, 650) = 77.079, $p = < 0.001$).

3.2.1 Changes in consumption before and after based on gender. As the number of people who self-identified as "other" was small, we performed the comparison based on gender by including only female and male respondents. In addition to the main effect of time reported in

Parameters		N (%)
Gender	Male	301 (46%)
	Female	340 (52%)
	Other	10 (2%)
Age	Below 30	330 (51%)
	30–50	245 (38%)
	Above 50	76 (11%)
Occupation	Student	284 (44%)
	Full-time employed	138 (21%)
	Freelancer	150 (23%)
	Homemaker	48 (7%)
	Unemployed	31 (5%)
Income	0–7,500	49 (7%)
	7,501–15,000	165 (25%)
	15,001–25,000	246 (38%)
	25,001–35,000	121 (19%)
	More than 35,001	70 (11%)
Family size (including the respondent)	1	33 (5%)
	2	78 (12%)
	3	210 (32%)
	4	252 (39%)
	5 or more	78 (12%)
Area of residence	North	187 (29%)
	Center	92 (14%)
	South	372 (57%)
Place of shopping	KM0	56 (8%)
	Online	30 (5%)
	Supermarket	371 (57%)
	Fruit seller	194 (30%)

Source(s): Authors' work

Table 2. Participants' demographic characteristics

the previous section, a two-way repeated-measure ANOVA on budget allocation showed a significant main effect of gender ($F(1, 587) = 5.399$, $p = 0.020$). Male participants were on average allocating a higher budget to fruit and vegetables ($M = 0.98$, $SD = 1.21$) than female participants ($M = 0.79$, $SD = 1.42$). This main effect was qualified by a significant interaction ($F(1, 587) = 5.767$, $p = 0.017$). While male participants ($M = 0.80$, $SD = 0.93$) were allocating more budget than females at T1 ($M = 0.49$, $SD = 0.94$; $p = < 0.001$), the difference becomes not significant at T2 ($p = 0.536$). The results are graphically presented in Figure 2. The other set of contrasts revealed that both male and female participants spent more on fruits and vegetables at T2 than at T1.

The results show no significant differences between females and males nor significant interaction effect on the weekly consumption of apples and the amount purchased at each shopping trip. These findings are different from previous literature which observed that men have a lower tendency to consume apples than women (Konopacka *et al.*, 2010). The difference might be due to the different consumption habits in the last decade among consumers.

3.2.2 Changes in consumption before and after based on age. To analyze the difference in consumption based on age, we created three age groups: below 30 years old, between 30 and 50 years old, and above 50 years old. In addition to the main effect of time reported in the previous section, a two-way repeated-measure ANOVA on budget allocation showed a significant main effect of age ($F(2, 586) = 53.076$, $p = < 0.001$). Participants between 30 and 50 were on average allocating a higher budget to fruit and vegetables ($M = 1.40$, $SD = 1.42$) than younger participants ($M = 0.60$, $SD = 0.90$) and older participants ($M = 0.56$, $SD = 0.89$). This main effect was qualified by a significant interaction ($F(2, 586) = 72.294$, $p = < 0.001$). Participants between 30 and 50 were spending less on fruits and vegetables at T1 ($M = 0.79$, $SD = 1.16$) than at T2 ($M = 2.02$, $SD = 1.51$). For the other groups, there was no significant difference between T1 and T2. The results are graphically shown in Figure 3. Looking at the other set of contrasts, both at T1 and T2, participants between 30 and 50 were significantly more likely to spend on fruits and vegetables than the other two groups.

The results show no significant interaction effect of age and time on the weekly consumption of apples and the amount purchased on each shopping trip. However, the results

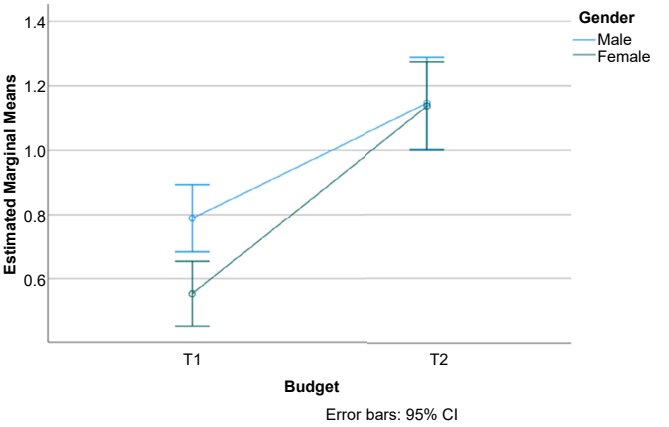
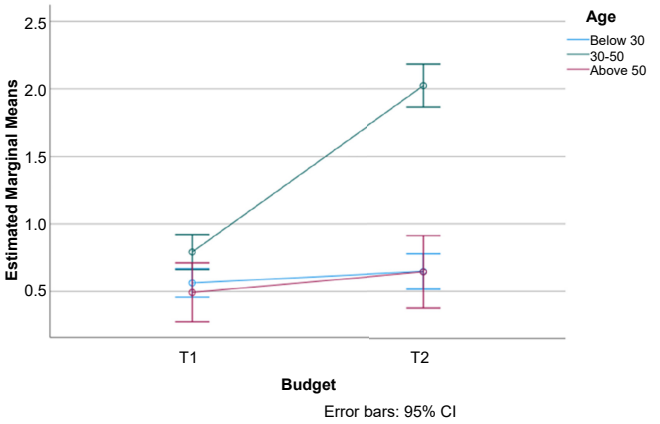


Figure 2.
Differences in budget allocation between T1 and T2 across gender

Note(s): The graph shows the difference in the budget allocated to fruits and vegetables at T1 and T2. Moreover, the lines indicate the difference in participants' allocation of budget depending on gender
Source(s): Authors' work



Note(s): The graph shows the difference in the budget allocated to fruits and vegetables at T1 and T2. Moreover, the lines indicate the difference in participants' allocation of budget depending on age
Source(s): Authors' work

Figure 3.
Differences in budget between T1 and T2 across age

indicate that only people below 50 increased the number of apples purchased on each trip before and after Covid-19. The difference was not significant for the participants above 50 years old. The findings are in line with previous literature that shows that younger generations are less likely to spend money on fruits and vegetables (e.g. Pérez-Rodrigo *et al.*, 2003). Moreover, the findings show that people above 50 were not much affected by COVID-19 lockdowns in terms of consumption habits.

3.3 Consumer cluster after the lockdown

Table 3 shows the results of the K-means cluster analysis used to identify the groups of participants based on similar eating motivation variables at T2. The analysis of the cluster centers and F statistics identified three meaningful clusters that differed according to the eating motives. The taxonomy description of the three clusters were: Cluster 1 (labeled "Practical consumer"; $n = 168$) was characterized by people who focus on how the apples are easily consumed or easy to prepare. Cluster 2 (labeled "Healthy consumer"; $n = 216$) was characterized by consumers who care about their health and having a healthy diet.

	Cluster 1 Practical consumer ($n = 168$)	Cluster 2 Healthy consumer ($n = 216$)	Cluster 3 Price sensitive consumer ($n = 267$)	F Statistics
TEMS_Health	−0.93	0.54	−0.23	209.040
TEMS_Natural Concerns	−1.19	0.38	0.48	316.514
TEMS_Price	−0.25	−0.28	0.99	124.171
TEMS_ Convenience	0.89	−0.06	−0.88	194.573

Source(s): Authors' work

Table 3.
Final cluster centers of TEMS variables

Finally, Cluster 3 (labeled "Price sensitive consumer"; $n = 267$) was characterized by people whose consumption is related to the product's price.

Table 4 shows the characteristics of the clusters according to sociodemographic aspects and consumption habits. The clusters did not differ according to the main demographic information except for geographical area and place of shopping. In particular, clusters 2 and 3 included more participants from the South than cluster 1. When it comes to places of shopping, cluster 1 has more people who use online shopping than the other two clusters. Moreover, people in clusters 2 and 3 are more likely to purchase from KM0 companies than people in cluster 1.

When clusters were compared for consumption habits after the pandemic, the results show that cluster 2 allocated less budget to fruits and vegetables than the other two clusters. There was no significant difference in budget allocation between clusters 1 and 3. Moreover, the three clusters did not differ in terms of the weekly consumption of apples. However, the three clusters behave differently in relation to the number of apples purchased on every shopping trip. In particular, cluster 1 purchased significantly fewer apples than cluster 2.

Overall, our main findings can be summarized in three key points. First, the results point to a difference in consumption habits and budget allocation between T1 and T2. In particular, after the lockdown, there has been an increase in the allocation of the budget to fruit and vegetables. Moreover, people have, on average, increased the consumption of apples and the number of apples purchased during every shopping trip.

Second, the change in the budget allocated was different based on the gender and age of the participants. In particular, while male participants were allocating more budget at T1, the difference becomes not significant at T2, signaling higher spending for fruit and vegetables in female participants. Moreover, people between 30 and 50 years old showed the highest increase in budget allocation.

Finally, based on the eating motivations at T2, we were able to identify three clusters that differ in consumption and food-related behavior. In particular, the "price-sensitive" consumer is identified as a consumer from the South of Italy, who buy apples from the fruit seller. Price-sensitive consumers have similar consumption habits to the "practical" consumer, who never buys KM0 products. Both clusters allocate more budget to fruits and vegetables than "healthy" consumers. However, differently from the other two clusters, healthy consumers usually purchase a higher number of apples per shopping trip. Across the three clusters, we did not find any difference based on the demographic characteristics of the sample.

4. Discussion and implications

The pandemic has led to many changes in consumption and eating habits, with an increasing trend in buying healthier products (Coulthard *et al.*, 2021). This trend has been justified for two main reasons. On the one hand, consumers have become more aware of the importance of adopting a healthy diet to keep the immune system in good health (Campos *et al.*, 2022). On the other hand, the need to buy local fresh products has grown, especially due to travel restrictions and difficulties in international trade (Ammann *et al.*, 2022; Ghufran *et al.*, 2022a; Kol *et al.*, 2023). For these reasons, many studies have focused on changes in consumption styles during and after the first Covid-19 global lockdown (e.g. Filimonau *et al.*, 2022; Ghufran *et al.*, 2022b; Başaran and Purut, 2021; Lamy *et al.*, 2022; Chenarides *et al.*, 2021). However, existing knowledge about the changes in food consumption over a long period of time after the pandemic event is scarce. In this research, we aim to address this gap by investigating whether the changes in consumption habits have had long-lasting consequences beyond 2020. Moreover, in the study, we investigated whether the consumption habits are similar across consumers or whether some groups have been more affected by the pandemic event than others.

Table 4. Consumer characteristics by cluster

			Cluster 1 Practical consumer (n = 168)	Cluster 2 Healthy consumer (n = 216)	Cluster 3 Price sensitive consumer (n = 267)	Chi square (df); p	ANOVA (df); p
Demographic information	Gender	Male	71	101	129	7.17 (4)	
		Female	91	113	136	p = 0.127	
		Other	6	2	2		
	Age	Below 30	78	121	131	6.25 (4)	
		30–50	73	68	104	p = 0.181	
		Above 50	17	27	32		
	Occupation	Student	64	105	115	5.72 (8)	
		Full-time employed	14	13	21	p = 0.678	
		Freelancer	38	41	59		
		Homemaker	44	45	61		
		Unemployed	8	12	11		
	Income	0–7,500	11	16	22	4.95 (8)	
		7,501–15,000	43	53	69	p = 0.762	
		15,001–25,000	58	85	103		
		25,001–35,000	35	35	51		
		More than 35,001	21	27	22		
	Family size (including the respondent)	1	9	10	14	12.34 (8)	
		2	18	27	33	p = 0.137	
		3	54	75	81		
		4	77	78	97		
		5 or more	10	26	42		
	Area of residence	North	61	62	64	9.28 (4)	
		Center	25	26	41	p = 0.054	
		South	82	128	372		
	Place of shopping	KM0	0	28	27	73.19 (8)	
		Online	21	0	9	P = < 0.001	
		Supermarket	112	126	134		
		Fruit seller	35	62	97		

(*continued*)

Table 4.

		Cluster 1 Practical consumer (n = 168)	Cluster 2 Healthy consumer (n = 216)	Cluster 3 Price sensitive consumer (n = 267)	Chi square (df); p	ANOVA (df); p
Consumption habits at T2	Budget allocated	M = 1.28 (SD = 1.41)	M = 0.87 (SD = 1.22)	M = 1.30 (SD = 1.35)		F(2, 625) = 7.167 p = < 0.001
	Weekly consumption	M = 1.43 (SD = 0.595)	M = 1.50 (SD = 0.595)	M = 1.48 (SD = 0.645)		F(2, 650) = 0.592 p = 0.553
	Number of apples purchased on every trip	M = 2.15 (SD = 0.543)	M = 2.32 (SD = 0.592)	M = 2.24 (SD = 0.713)		F(2, 650) = 3.624 p = 0.027
Clustering variables	TEMS_Health	M = 4.23 (SD = 1.06)	M = 5.45 (SD = 1.08)	M = 5.59 (SD = 0.54)		F(2, 650) = 132.340 p = < 0.001
	TEMS_Natural Concerns	M = 3.66 (SD = 0.88)	M = 5.64 (SD = 0.80)	M = 5.39 (SD = 0.72)		F(2, 650) = 342.466 p = < 0.001
	TEMS_Price	M = 4.13 (SD = 1.31)	M = 3.48 (SD = 0.93)	M = 5.50 (SD = 0.99)		F(2, 650) = 224.698 p = < 0.001
	TEMS_Convinience	M = 5.23 (SD = 0.83)	M = 3.29 (SD = 0.76)	M = 4.27 (SD = 1.07)		F(2, 650) = 210.904 p = < 0.001

Source(s): Authors' work

Our findings provide both theoretical and practical contributions. First, we contribute to the current literature about changes in consumption habits. The results from a sample of 651 Italian consumers showed that the consumption of fruit and vegetables, especially apples, significantly increased between 2021 and 2022. The findings are in line with other trends observed globally. For example, Isaskar and Perwitasari (2021) show that the Covid-19 pandemic has led to a change in consumption style and that consumers have oriented their diet toward healthier and more nutritious foods, which a specific increase in the consumption of fruit and vegetables. Moreover, according to Revoredo-Giha *et al.* (2022), there has been a significant increase in spending on domestic consumption of both fruit and vegetables during the pandemic period. However, the per capita expenditure on fresh fruit and vegetables in the fourth quarter of 2020 grew less than the per capita expenditure on other food products. Our results are also consistent with studies conducted by Sooriyaarachchi *et al.* (2022) whose findings show that the consumption of locally produced fruit and vegetables during the pandemic period has increased considerably.

The increase in consumption of fruits and vegetables during and after the first lockdown was also observed in Italy. In particular, previous research has observed that the change in Italians' interest in healthy eating might explain the different consumption patterns (Maugeri *et al.*, 2023). However, in the post-lockdown period in 2020, the new healthy consumption model acquired by Italians was partially interrupted (Caso *et al.*, 2022). According to these authors, the changes in consumption were driven not by an increase in healthier food consumption after the lockdown but by a continuous decrease in the intake of "junk" food during the lockdown. Thus, we expand the current literature by showing that the change in recent times is not only related to the reduction in the consumption of junk food but also to an increase in healthier options that seem to be a stable trend almost two years after the beginning of the pandemic.

Second, our results also expand the literature on the differences in consumption habits depending on people's sociodemographic characteristics. The findings show that while male consumers were allocating more budget to fruits and vegetables during the lockdown, the difference disappears after the lockdown. Thus, female consumers have been starting to allocate more budget to fruits and vegetables as a result of the lockdown. The results are in line with previous literature which shows that female consumers are more likely to buy and consume fruit and vegetables than male consumers (Ahmadi Kaliji *et al.*, 2022; Mngomezulu *et al.*, 2022).

The empirical results also showed that participants belonging to the age group between 30 and 50 allocated on average a larger budget for fruit and vegetables than the other two groups. This effect was qualified by a significant interaction, in which this age group spent less on fruit and vegetables than the other groups during the lockdown and more when the Covid-19 health emergency ended. These results provide new insights as current findings mostly focus on documenting the fact that people above 50 are more likely to consume fruit and vegetables than younger generations (Lee *et al.*, 2022).

Finally, from the identification of the three clusters of consumers (1) practical, (2) healthy, and (3) price-sensitive, it emerged that health-conscious consumers have bought significantly more apples since the post-lockdown. However, the other two clusters have increased the overall budget allocated to fruits and vegetables. The findings expand the current knowledge about consumers' habits and provide new insights into the knowledge on what consumers do and where they purchase fruit and vegetables.

The paper also enriches scientific knowledge about the dynamics of consumer preferences and consumption, contributing to the definition of food and public health policies aimed at promoting correct and healthy eating behaviors and styles. Therefore, the results of this study could have important social and economic implications related to the consumption of

apples. In particular, the observation that consumers belonging to the "health" cluster tend to buy a greater number of apples could open up a new market potential for sector operators.

The main implications of the study on the theoretical point of view could be summarized in the following considerations: the study contributes to the understanding of how a global pandemic like COVID-19 can have enduring effects on consumer behavior. It highlights that changes in consumption patterns observed during and after the initial lockdown have persisted over an extended period. The study reinforces the idea that health-conscious consumption has become a prevailing trend. Consumers are increasingly prioritizing healthier food options, as evidenced by the increased budget allocation for fruits and vegetables. The identification of distinct consumer clusters based on eating motivations provides a valuable tool for market segmentation and targeted marketing strategies.

The main implications of the study on the practical and political point of view could be: food companies and retailers can use the findings to adapt their marketing and communication strategies. Understanding the increased focus on health-conscious consumption and recognizing that "health-conscious consumers" tend to buy more apples can prompt product development and marketing campaigns focused on the health benefits of apples. Health authorities and policymakers can use the study's insights to design public health initiatives that encourage healthier eating habits. Promoting the consumption of fruits and vegetables, particularly among specific age and gender groups, can be a part of broader public health campaigns. Governments can invest in educational programs that raise awareness about the importance of a balanced diet and the health benefits of fruits and vegetables. These programs can target specific demographics identified in the study, such as age and gender groups. The study's insights can be used to develop food security initiatives that ensure access to affordable, healthy food options for vulnerable populations. Policymakers can also support further research and data collection on dietary habits to continually refine policies and interventions. Longitudinal studies can help track changes in eating patterns and their impact on public health.

However, it must be emphasized that further research is needed to assess whether this changed consumer attitude will remain stable over time. Only through in-depth and continuous analysis, it will be possible to fully grasp the opportunities that emerge from the change in consumption habits and anticipate market trends.

5. Conclusions, limitations, and future research directions

The paper analyzed the long-term impact of the lockdown during and after the COVID-19 pandemic on food consumption. The research shows a significant increase in the budget for the purchase of fruit and vegetables after the lockdown, together with an increase in the consumption of apples. Moreover, the study investigated the socio-demographic and eating motives that predict consumption choices after the lockdown.

Despite the relevance of our findings, the study comes with some limitations. First, given the lack of data, we were not able to compare consumption motives before and after the lockdown but we only focused on the drivers of consumption after the lockdown. Also, the study adopts a non-probabilistic sample (a snowball sample approach) which comes with its own limitations such as the fact that not all members of a group have an equal chance of being selected. The sample group is not chosen through random selection, making it susceptible to a margin of error. Future studies could implement an experimental approach to test for the causal effects of our findings and adopt a probabilistic sample technique.

Moreover, although we collected information about the budget for fruits and vegetables, we collected information only on the consumption of apples. Future studies could expand our findings to different product categories and include other consumption motives. Finally, our data collection focuses on the Italian market in a specific historical period and under specific

regulations (e.g. the COVID-19 pandemic). However, future studies on these topics should be conducted outside Italy, in non-western cultures, to investigate the generalizability of our findings and test for possible cross-cultural differences. For instance, in regions where apple consumption is less common, people highly committed to eating healthy may engage in different motivated-cognitive processes than the ones discussed in this study. Moreover, other regulations in the market might affect the consumption habits of consumers.

References

Ahmadi Kaliji, S., Imami, D., Canavari, M., Gjonbalaj, M. and Gjokaj, E. (2022), "Fruit-related lifestyles as a segmentation tool for fruit consumers", *British Food Journal*, Vol. 124 No. 13, pp. 126-142, doi: 10.1108/bfj-09-2021-1001.

Alaimo, L.S., Fiore, M. and Galati, A. (2020), "How the COVID-19 pandemic is changing online food shopping human behaviour in Italy", *Sustainability (Switzerland)*, Vol. 12 No. 22, p. 9594, 9594, 1-18, doi: 10.3390/su12229594.

Alaimo, L.S., Fiore, M. and Galati, A. (2022), "Measuring consumers' level of satisfaction for online food shopping during COVID-19 in Italy using POSETs", *Socio-Economic Planning Sciences*, Vol. 82, 101064, doi: 10.1016/j.seps.2021.101064.

Ammann, J., Ritzel, C. and El Benni, N. (2022), "How did the COVID-19 pandemic influence health-related behavior? An online survey on food choice, physical activity, and changes in body weight among Swiss adults", *Food Quality and Preference*, Vol. 100, 104625, doi: 10.1016/j.foodqual.2022.104625.

Anderson, A.S., Hunt, K., Ford, G. and Finnigan, F. (1994), "One apple a day? - fruit and vegetable intake in the West of Scotland", *Health Education Research*, Vol. 9 No. 3, pp. 297-305, doi: 10.1093/her/9.3.297.

Assomela (2022), Update on the Market, available at: http://www.assomela.it/index_it.html

Başaran, B. and Purut, H.P. (2021), "The impact of the COVID-19 pandemic on the frequency of food consumption", *Journal of Tourism and Gastronomy Studies*, Vol. 9 No. 1, pp. 47-66, doi: 10.21325/jotags.2021.776.

Bonany, J., Buehler, A., Carbó, J., Donati, F., Echeverria, G., Egger, S., Guerra, W., Hilaire, C., Höller, I., Iglesias, I., Jesionkowska, K., Konopacka, D., Kruczyńska, D., Martinelli, A., Pitiot, C., Sansavini, S., Schoorl, F., Stehr, R. and Schoorl, F. (2013), "Consumer eating quality acceptance of new apple varieties in different European countries", *Food Quality and Preference*, Vol. 30 No. 2, pp. 250-259, doi: 10.1016/j.foodqual.2013.06.004.

Bossi Fedrigotti, V. and Fischer, C. (2020), "Why per capita apple consumption is falling: insights from the literature and case evidence from South Tyrol", *Horticulturae*, Vol. 6 No. 4, p. 79, doi: 10.3390/horticulturae6040079.

Campos, P.D.O., Mélo, L.B.D., de Souza, J.C.V., Santana, P.N.D., Matte, J. and Costa, M.F.D. (2022), "Consumer fear and healthy eating during COVID-19 pandemic", *Marketing Intelligence and Planning*, Vol. 40 No. 2, pp. 227-241, doi: 10.1108/mip-04-2021-0125.

Caso, D., Guidetti, M., Capasso, M. and Cavazza, N. (2022), "Finally, the chance to eat healthily: longitudinal study about food consumption during and after the first COVID-19 lockdown in Italy", *Food Quality and Preference*, Vol. 95, 104275, doi: 10.1016/j.foodqual.2021.104275.

Ceschi, S., Canavari, M. and Castellini, A. (2018), "Consumer's preference and willingness to pay for apple attributes: a choice experiment in Large retail outlets in Bologna (Italy)", *Journal of International Food and Agribusiness Marketing*, Vol. 30 No. 4, pp. 305-322, doi: 10.1080/08974438.2017.1413614.

Chen, J., Zhang, Y., Zhu, S. and Liu, L. (2021), "Does COVID-19 affect the behavior of buying fresh food? Evidence from Wuhan, China", *International Journal of Environmental Research and Public Health*, Vol. 18 No. 9, p. 4469, doi: 10.3390/ijerph18094469.

Chenarides, L., Grebitus, C., Lusk, J.L. and Printezis, I. (2021), "Food consumption behavior during the COVID-19 pandemic", *Agribusiness*, Vol. 37 No. 1, pp. 44-81, doi: 10.1002/agr.21679.

Coldiretti (2019), "Fruits and vegetables", available at: https://www.coldiretti.it/prodotto/ortofrutta

Coulthard, H., Sharps, M., Cunliffe, L. and van den Tol, A. (2021), "Eating in the lockdown during the Covid 19 pandemic; self-reported changes in eating behaviour, and associations with BMI, eating style, coping and health anxiety", *Appetite*, Vol. 161, 105082, doi: 10.1016/j.appet.2020.105082.

Crea (2020), *The Impact of COVID-19 on Italian Consumption Habits during March-April 2020 Lockdown. Special Issue*, ERSA, Roma.

Denver, S. and Jensen, J.D. (2014), "Consumer preferences for organically and locally produced apples", *Food Quality and Preference*, Vol. 31, pp. 129-134, doi: 10.1016/j.foodqual.2013.08.014.

Dumitras, D.E., Harun, R., Arion, F.H., Kovacs, E., Oroian, C.F., Porutiu, A. and Muresan, I.C. (2021), "Food consumption patterns in Romania during the covid-19 pandemic", *Foods*, Vol. 10 No. 11, p. 2712, doi: 10.3390/foods10112712.

Filimonau, V., Beer, S. and Ermolaev, V.A. (2022), "The COVID-19 pandemic and food consumption at home and away: an exploratory study of English households", *Socio-Economic Planning Sciences*, Vol. 82, 101125, doi: 10.1016/j.seps.2021.101125.

Gardner, H.K. and Matviak, I. (2020), "Coronavirus could force teams to work remotely", *Harvard Business Review*, Vol. 5, available at: https://hbr.org/2020/03/coronavirus-could-force-teams-to-work-remotely

Gallus, S., Talamini, R., Giacosa, A., Montella, M., Ramazzotti, V., Franceschi, S., Negri, E. and La Vecchia, C. (2005), "Does an apple a day keep the oncologist away?", *Annals of Oncology*, Vol. 16 No. 11, pp. 1841-1844, doi: 10.1093/annonc/mdi361.

Ghufran, M., Ali, S., Ariyesti, F.R., Nawaz, M.A., Aldieri, L. and Xiaobao, P. (2022a), "Impact of COVID-19 to customers switching intention in the food segments: the push, pull and mooring effects in consumer migration towards organic food", *Food Quality and Preference*, Vol. 99, 104561, doi: 10.1016/j.foodqual.2022.104561.

Ghufran, M., Ashraf, J., Ali, S., Xiaobao, P. and Aldieri, L. (2022b), "Effect of consumption value on consumer willingness to consume GM food: a post-COVID-19 analysis", *Foods*, Vol. 11 No. 18, p. 2918, doi: 10.3390/foods11182918.

Grosso, G., Mistretta, A., Turconi, G., Cena, H., Roggi, C. and Galvano, F. (2013), "Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy", *Public Health Nutrition*, Vol. 16 No. 10, pp. 1827-1836, doi: 10.1017/s1368980012003965.

Güney, O.I. and Sangün, L. (2021), "How COVID-19 affects individuals' food consumption behavior: a consumer survey on attitudes and habits in Turkey", *British Food Journal*, Vol. 123 No. 7, pp. 2307-2320, doi: 10.1108/bfj-10-2020-0949.

Hartman, H., Wadsworth, D.P., Penny, S., van Assema, P. and Page, R. (2013), "Psychosocial determinants of fruit and vegetable consumption among students in a New Zealand university. Results of focus group interviews", *Appetite*, Vol. 65, pp. 35-42, doi: 10.1016/j.appet.2013.02.005.

Hurgobin, Y., Le Floch, V. and Lemercier, C. (2020), "Effect of multiple extrinsic cues on consumers' willingness to buy apples: a scenario-based study", *Food Quality and Preference*, Vol. 81, 103860, doi: 10.1016/j.foodqual.2019.103860.

Isaskar, R. and Perwitasari, H. (2021), "Consumer preference for local apples Malang and imported apples during the pandemic", In *E3S Web of Conferences*, EDP Sciences, Vol. 316, p. 01009.

ISMEA (1994), "Consumption of apples", available at: www.ismea.it

Jia, P., Liu, L., Xie, X., Yuan, C., Chen, H., Guo, B. and Yang, S. (2021), "Changes in dietary patterns among youths in China during COVID-19 epidemic: the COVID-19 impact on lifestyle change survey (COINLICS)", *Appetite*, Vol. 158, 105015, doi: 10.1016/j.appet.2020.105015.

Kamphuis, C.B., Giskes, K., de Bruijn, G.J., Wendel-Vos, W., Brug, J. and Van Lenthe, F.J. (2006), "Environmental determinants of fruit and vegetable consumption among adults: a systematic review", *British Journal of Nutrition*, Vol. 96 No. 4, pp. 620-635.

Kol, O., Zimand-Sheiner, D. and Levy, S. (2023), "A (local) apple a day: pandemic-induced changes in local food buying, a generational cohort perspective", *European Journal of International Management*, Vol. 19 No. 1, pp. 1-26, doi: 10.1504/ejim.2023.127297.

Konopacka, D., Jesionkowska, K., Kruczyńska, D., Schoorl, F., Buehler, A., Egger, S., Codarin, S., Hilaire, C., Höller, I., Guerra, W., Liverani, A., Donati, F., Sansavini, S., Martinelli, A., Petiot, C., Carbó, J., Echeverria, G., Bonany, J., Iglesias, I. and Bonany, J. (2010), "Apple and peach consumption habits across European countries", *Appetite*, Vol. 55 No. 3, pp. 478-483, doi: 10.1016/j.appet.2010.08.011.

Korn, M., Belkin, D. and Chung, J. (2020), "Coronavirus pushes colleges to the breaking point, forcing 'hard choices' about education", *Wall Street Journal*, April 30, available at: https://www.wsj.com/articles/coronavirus-pushes-colleges-to-the-breaking-point-forcing-hard-choices-about-education-11588256157

Lamy, E., Viegas, C., Rocha, A., Lucas, M.R., Tavares, S., E Silva, F.C., Guedes, D., Laureati, M., Zian, Z., Salles Machado, A., Ellssel, P., Freyer, B., González-Rodrigo, E., Calzadilla, J., Majewski, E., Prazeres, I., Silva, V., Juračak, J., Platilová Vorlíčková, L., Kamutali, A., Regina Tschá, E., Villalobos, K., Želvytė, R., Monkeviciene, I., Elati, J., de Souza Pinto, A.M., Midori Castelo, P. and Anzman-Frasca, S. (2022), "Changes in food behavior during the first lockdown of the COVID-19 pandemic: a multi-country study about changes in eating habits, motivations, and food-related behaviors", *Food Quality and Preference*, Vol. 99, 104559, doi: 10.1016/j.foodqual.2022.104559.

Lanfranchi, M., Giannetto, C., Alibrandi, A. and Zirilli, A. (2015), "Analysis of the propensity to fruit consumption among young people through the cumulative proportional odds model", *American Journal of Applied Sciences*, Vol. 12 No. 8, pp. 542-548, doi: 10.3844/ajassp.2015.542.548.

Lanfranchi, M., Zirilli, A., Passantino, A., Alibrandi, A. and Giannetto, C. (2017), "Assessment of milk consumer preferences: identifying the choice factors through the use of a discrete logistic model", *British Food Journal*, Vol. 119 No. 12, pp. 2753-2764, doi: 10.1108/bfj-04-2017-0210.

Lee, S.H., Moore, L.V., Park, S., Harris, D.M. and Blanck, H.M. (2022), "Adults meeting fruit and vegetable intake recommendations—United States, 2019", *Morbidity and Mortality Weekly Report*, Vol. 71 No. 1, pp. 1-9, doi: 10.15585/mmwr.mm7101a1.

MacQueen, J. (1965), "Some methods for classification and analysis of multivariate observations", *Proc. 5th Berkeley Symposium on Math., Stat., and Prob*, p. 281.

Maugeri, A., Barchitta, M., Perticone, V. and Agodi, A. (2023), "How COVID-19 pandemic has influenced public interest in foods: a Google trends analysis of Italian data", *International Journal of Environmental Research and Public Health*, Vol. 20 No. 3, p. 1976, doi: 10.3390/ijerph20031976.

Mattioli, A.V., Sciomer, S., Cocchi, C., Maffei, S. and Gallina, S. (2020), "Quarantine during COVID-19 outbreak: changes in diet and physical activity increase the risk of cardiovascular disease", *Nutrition, Metabolism and Cardiovascular Diseases*, Vol. 30 No. 9, pp. 1409-1417, doi: 10.1016/j.numecd.2020.05.020.

Migliore, G., Galati, A., Romeo, P., Crescimanno, M. and Schifani, G. (2015), "Quality attributes of cactus pear fruit and their role in consumer choice: the case of Italian consumers", *British Food Journal*, Vol. 117 No. 6, pp. 1637-1651, doi: 10.1108/bfj-04-2014-0147.

Mngomezulu, K., Ndinda, C., Mazamane, Z., Sinyolo, S. and Adebayo, P. (2022), "Gendered attitudes to fruit and vegetable consumption during the COVID-19 epidemic: implications for policy and programming", *Agenda*, Vol. 36 No. 2, pp. 77-91, doi: 10.1080/10130950.2022.2096791.

Muder, A., Garming, H., Dreisiebner-Lanz, S., Kerngast, K., Rosner, F., Kličková, K., Kurthy, G., Cimer, K., Bertazzoli, A., Altamura, V., De Ros, G., Zmarlicki, K., de Belém Costa Freitas, M., Duarte, A., Bravin, E., Kambor, J., Karamürsel, D., Pınar Öztürk, F., Kaçal, E. and Kaçal, E. (2022), "Apple

production and Apple value chains in Europe", *European Journal of Horticultural Science*, Vol. 87 No. 6, pp. 1-22, doi: 10.17660/ejhs.2022/059.

Pérez-Rodrigo, C., Ribas, L., Serra-Majem, L.L. and Aranceta, J. (2003), "Food preferences of Spanish children and young people: the enKid study", *European Journal of Clinical Nutrition*, Vol. 57 No. 1, pp. S45-S48, doi: 10.1038/sj.ejcn.1601814.

Punj, G. and Stewart, D.W. (1983), "Cluster analysis in marketing research: review and suggestions for application", *Journal of Marketing Research*, Vol. 20 No. 2, pp. 134-148, doi: 10.2307/3151680.

Renner, B., Sproesser, G., Strohbach, S. and Schupp, H.T. (2012), "Why we eat what we eat. The Eating Motivation Survey (TEMS)", *Appetite*, Vol. 59 No. 1, pp. 117-128, doi: 10.1016/j.appet.2012.04.004.

Revoredo-Giha, C., Russo, C. and Twum, E.K. (2022), "Purchases of fruit and vegetables for at home consumption during COVID-19 in the UK: trends and determinants", *Frontiers in Nutrition*, Vol. 9, 847996, doi: 10.3389/fnut.2022.847996.

Richards, T.J. and Rickard, B. (2020), "COVID-19 impact on fruit and vegetable markets", *Canadian Journal of Agricultural Economics*, Vol. 68 No. 2, pp. 189-194, doi: 10.1111/cjag.12231.

Rombach, M., Dean, D.L. and Baird, T. (2022a), "Understanding apple attribute preferences of US consumers", *Foods*, Vol. 11 No. 2, p. 166, doi: 10.3390/foods11020166.

Rombach, M., Dean, D.L., Baird, T. and Kambuta, J. (2022b), "COVID-19 and the locavores: investigating the drivers of US consumer preferences for apples", *Agronomy*, Vol. 12 No. 7, p. 1691, doi: 10.3390/agronomy12071691.

Sooriyaarachchi, P., Francis, T.V. and Jayawardena, R. (2022), "Fruit and vegetable consumption during the COVID-19 lockdown in Sri Lanka: an online survey", *Nutrire*, Vol. 47 No. 2, p. 12, doi: 10.1186/s41110-022-00161-z.

Verzeletti, C., Maes, L., Santinello, M., Baldassari, D. and Vereecken, C.A. (2010), "Food-related family lifestyle associated with fruit and vegetable consumption among young adolescents in Belgium Flanders and the Veneto Region of Italy", *Appetite*, Vol. 54 No. 2, pp. 394-397, doi: 10.1016/j.appet.2009.12.010.

Who (2023), "WHO coronavirus (COVID-19) dashboard", available at: https://covid19.who.int/

Wang, L. and Huo, X. (2016), "Willingness-to-pay price premiums for certified fruits. A case of fresh apples in China", *Food Control*, Vol. 64, pp. 240-246, doi: 10.1016/j.foodcont.2016.01.005.

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