Food safety and consumption patterns in the Campania region during the COVID-19 emergency

Roberta Brunetti,[1] Stefania Cavallo,[1] Eloise Peirce,[1] Roberta Pellicanò,[1] Diletta Mandato,[2] Francesca Romano,[1] Ivana Elefante,[1] Germana Colarusso,[1] Pellegrino Fenizia,[1] Federica Gargano,[1] Loredana Baldi,[1] Rosa D'Ambrosio[1]

[1]Experimental Zooprophylactic Institute of Southern Italy, Portici, Naples; [2]Local Health Authority Naples 2 North - Campania Region, Naples, Italy

Abstract

The objective of this study was to evaluate the association between consumers' experience of COVID-19 and changes in their food purchasing decisions during the lockdown as a result of their risk perception. An online questionnaire was created to analyze consumer purchasing behavior and awareness during the pandemic. At the end of the online administration period, the replies collected were downloaded. A descriptive analysis of the data was carried out through the construction of tables of individual variables; for each variable, the patterns, frequencies, and percentages with which they occurred were determined. Subsequently, a multiple correspondence analysis (MCA) was conducted; this is one of the most widely used statistical techniques for the "multiple" analysis of qualitative or mixed data collected through questionnaires. The final extraction of the completed questionnaires returned the replies of 114 individuals. In the MCA, not all the variables of the matrix were considered, as they were not proportional to the number of individuals. We considered 7 active variables and 1 supplementary variable, which contributed to the formation of factors. The most notable pattern was that those people who were most worried about the risk of contagion not only sanitized their purchases but also reduced their online purchases and deliveries, believing that these measures could reduce the risk of contagion.

Correspondence: Stefania Cavallo, Experimental Zooprophylactic Institute of Southern Italy, via Salute 2, 80055 Portici, Naples, Italy.
E-mail: stefania.cavallo@izsmportici.it

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Introduction

A novel coronavirus disease, named "COVID-19" by the World Health Organization, was initially reported in the city of Wuhan, China, in December 2019. Subsequently, it spread rapidly around the world, resulting in a global pandemic. The COVID-19 pandemic not only affected human health but also caused several economic and social changes (Li *et al.*, 2021). To curb the spread of COVID-19, at the beginning of March 2020, the Italian government implemented stringent containment measures; mass gatherings and events and non-urgent meetings were banned throughout the country. Following the "#iorestoacasa decree" ("#stayathome decree") (Ministry of Labor and Social Policy, 2020), people's habits and lifestyles changed suddenly and radically, and all forms of socialization were drastically reduced. Physical distancing and self-isolation strongly impacted citizens' lives, affecting eating habits and everyday behaviors (Di Renzo *et al*., 2020). Two major changes occurred: people stayed at home (engaging in online education or smart working and limiting outdoor and indoor physical activity), and many stockpiled food owing to restrictions on grocery shopping. In addition, the interruption of people's work routine caused by the lockdown may have resulted in boredom, and continually hearing or reading media reports about COVID-19 may have been stressful (Moynihan *et al*., 2015). Several studies have investigated whether consumers' food shopping patterns were affected by the COVID-19-related lockdown. Indeed, survival psychology has ascertained that individuals may alter their behavior in response to specific circumstances (Balzan *et al.*, 2014), such as natural disasters and health emergencies, and these behavioral shifts may affect attitudes and behaviors related to food consumption (Loxton, 2020). In Italy, Di Renzo *et al*. (2020) investigated the relationship between eating habits and mental and emotional states during the COVID-19 pandemic. The COVID-19 pandemic created

unpredictable and unprecedented disruptions in every domain of social and economic life. During the first phase of the pandemic, consumers experienced a feeling of "outrage" (offense, fear, anger), which influenced their perception of risk and, consequently, their food choices. This perception was also exacerbated by alarmist media coverage.

Materials and Methods

Drafting a questionnaire to analyze consumer purchasing behavior and awareness

To collect and process information of interest, a targeted questionnaire was created and administered with the aim of providing a hypothetical model for analyzing consumer purchasing behavior and awareness (EpiCentro, 2020; IZSVe, 2020; European Commission, 2020). At the end of the questionnaire, a question was inserted whose purpose was to verify whether, during the pandemic, in addition to eating habits, the perception of risk was more linked to "food" factors or to external factors that influence daily life.

It is known that excessively long questionnaires can impair the overall quality of the information collected, in terms of both incomplete questionnaires and the reliability of answers, owing to the "boredom" factor. For this reason, the questionnaire was deliberately limited to 18 questions, and the structure of the questions was designed in such a way as to allow comparable data collection through specific statistical analyses.

The questions were ordered in such a way as to ensure a logical succession of the topics covered, and the questionnaire was divided into two sections: personal data, collected in a form that guarantees anonymity, according to the indications of the General Data Protection Regulation (GDPR - https://eur-lex.europa.eu/EN/legal-content/summary/general-data-protection-regulation-gdpr.html) and eating habits during the COVID-19 pandemic.

A funnel style was used in ordering the questions, *i.e.*, we moved from general questions to specific questions to allow respondents to correctly focus their attention on the proposed topic.

Pre-test phase and online publication of the questionnaire

The questionnaire was subjected to a pre-test phase of verification and control before being published online. The objective of pre-testing is to increase the validity and reliability of the survey. Indeed, when questionnaires undergo pre-testing, we focus on how people answer the questions, given that interviewees may implement a multitude of different mental processes, not all of which are predictable and/or consistent with the objectives.

The pre-test was administered to a group of people who were not aware of the objectives and content of the project. Administration was followed by a debriefing session, in which the critical issues that emerged were examined and their possible solutions assessed. This process yielded the final version of the questionnaire. Obviously, owing to the pandemic, it was not possible to administer the questionnaire directly to consumers, for example, by placing a stand outside selected retail outlets. Instead, we used an online format alone and set a mandatory reply for each question to guarantee the completeness of the data.

The questionnaire was published online on the home pages of the Experimental Zooprophylactic Institute of Southern Italy (IZSM) and Regional Food Safety Observatory (ORSA) websites and relaunched through the main social platforms, Facebook and Instagram, from 1 March to 30 November 2022. At the end of the online administration period, the replies collected were downloaded. A descriptive analysis of the data was carried out by calculating, for each question, the frequencies and percentages of the answers provided. The data were processed with the statistical software RStudio version 4.4.1

Multiple correspondence analysis

Multiple correspondence analysis (MCA) is a multidimensional data analysis method used in sociological, economic, ecological, and health studies, *i.e.*, areas in which many phenomena are observed using non-quantitative scales (Zani, 2000; Piccolo, 2010). This is currently one of the most widely used statistical techniques for the "multiple" analysis of qualitative or mixed data collected through questionnaires. In MCA, it is necessary to transform the original data in such a way that every single answer provided in the questionnaire takes on the role of "modality" and each modality becomes a "dichotomous variable". The method aims to construct a series of factors derived from the combination of those dichotomous variables that are most closely correlated with one another, which tend to form a group. These factors express some concepts that are not directly observable in reality but originate from the measurement of a set of variables.

Correspondence analysis presupposes some crucial decisions: choice of the number of variables and choice of the number of factors. For MCA, the response modes "No" and "Yes" become two variables, each of which will take on the value of "1" or "2", according to the answer provided. This process is repeated for each of the selected questions, thus yielding a new matrix of variables with values "1" and "2" on which to apply the MCA. We can distinguish two types of variables: i) active variables – those that enter directly into the analysis and contribute to the formation of the factors; ii) supplementary or illustrative variables – "passive" variables, which are excluded from the formation of the factors but are subsequently used as an aid to their interpretation. The MCA technique applies exclusively to the "active variables" and leads to the construction of a certain number of "factors", which derive from the combination of the original variables that are most closely correlated with one another. Subsequently, the method involves choosing a defined number of Factors whose cumulative percentage explains the variability of the data on the phenomenon (Scree plot graph). The factors chosen by the analysis allow the creation of a further graph (Biplot), in which the factors become the Cartesian axes of the graph, onto which the dichotomous variables considered are projected. The abscissa of the plane corresponds to "dimension1" and the ordinate to "dimension2". As regards the "units", *i.e.*, the number of completed questionnaires, very often their projection in the Biplot graph has no particular relevance; however, if a supplementary variable of particular interest can be identified, it is possible to project the units to identify groups with relevant characteristics. The proximity between two points highlights modalities that have been chosen by the same subjects or by very similar subjects, and proximity between two modalities can be interpreted in terms of associations between them.

Results

The final extraction of the completed questionnaires returned replies from 114 individuals to 18 questions, divided into two sections: i) personal data; ii) eating habits during the COVID-19 pandemic.

Personal data

The most represented age group is 35-44 (34%), although the other age groups are also well represented. More women than men (70% *vs.* 30%) completed the questionnaire. Most of the responses come from Campania (76%), the IZSM's region of area of responsibility. In 75% of the households, there are more than two people, and 66% stated that they have children. Of the respondents, 61% are office workers, and 66% are university graduates. Table 1 shows the relative and absolute frequencies of replies to each question in the personal data section.

Eating habits during the COVID-19 pandemic

In this section, the replies made different options available. In all cases, variations were recorded, and different profiles were identified. Concerning "online shopping", more respondents increased this type of purchase (24%) than those who reduced it (3%). Regarding "shopping at the store", the percentages of those who increased and those who reduced this type of shopping were substantially the same. For what concerns "takeaway food delivery", more subjects increased this type of supply (32%) than those who reduced it (9%) (Figure 1a). In answer to the question "when you go shopping, what type of food do you prefer to buy?", 82% of respondents expressed a preference for fresh, quality foods (Figure 1b). There was a slight prevalence of those who increased their shopping frequency (30%) over those who reduced it (20%) (Figure 1c). The percentages of those who expressed the belief that sanitizing shopping reduces the risk of contagion and those who believed that this practice has no influence were almost the same (Figure 1d). Within each graph, the "NAs" are missing values or non-responses.

"Unpackaged bread" was eliminated by 14% of respondents, while 7% introduced it; the former (that is, those who eliminated non-packaged bread) may have been people who believed that using an industrially packaged product could reduce the risk of contracting COVID-19. "Preserved fish" was introduced by only 4% of respondents, while 28% eliminated it; this latter change could be explained by the fact that preserved fish is often used as a meal outside the home (Table 2).

One of the most interesting results concerns the 23% of subjects who expressed little worry about the possibility of having an allergic reaction to a food (Table 3).

To the question "generally speaking, which risk do you perceive

Table 1. Absolute and relative frequencies of the "personal data" section.

	Whole sample n=114
Age, n (%)	
<35	25 (0.22)
35-44	39 (0.34)
45-54	31 (0.27)
>54	19 (0.17)
Gender, n (%)	
Female	80 (0.70)
Male	34 (0.30)
Nation, n (%)	
Italy	113 (0.99)
Abroad (other continent)	1 (0.01)
Region, n (%)	
Abruzzo	1 (0.01)
Basilicata	1 (0.01)
Calabria	2 (0.02)
Campania	87 (0.76)
Emilia-Romagna	4 (0.04)
Lazio	5 (0.04)
Lombardy	4 (0.04)
Piedmont	4 (0.04)
Sicily	2 (0.02)
Tuscany	2 (0.02)
Umbria	1 (0.01)
Veneto	1 (0.01)
Family members, n (%)	
1	5 (0.04)
2	24 (0.21)
>2	85 (0.75)
Do you have children?, n (%)	
No	39 (0.34)
Yes	75 (0.66)
Qualification, n (%)	
Unemployed	23 (0.20)
Employed	70 (0.61)
Retired	12 (0.11)
Student	9 (0.08)
Educational qualification, n (%)	
Middle school	5 (0.04)
High school	34 (0.30)
Degree	75 (0.66)

Table 2. Percentages of changes in eating habits.

Eating habits	Eliminated (%)	Introduced (%)	Unchanged (%)	NA (no answers) (%)
Packaged bread	12	13	69	6
Unpackaged bread	14	7	74	5
Fresh meat and offal	8	3	84	5
Frozen meat and offal	27	7	59	7
Fresh fish	11	8	75	6
Frozen fish	12	17	65	6
Preserved fish	28	4	58	10
Canned fish	8	4	81	7
Vegetables	3	13	81	3
Sweets	10	9	77	4
Ready meals	31	6	58	5
Bakery products	9	11	80	0
Alcohol	15	10	75	0

as closest to your daily life?", the only noteworthy feature was that only 8% of subjects perceived the risk of being a victim of terrorism as very close; this was probably due to the fact that the questionnaire was administered during the pandemic period, far from terrorist attacks (Table 4).

Multiple correspondence analysis

The active variables that contributed to the formation of the factors were the following: i) changes in online shopping: 3 modes (increase, decrease, unchanged); ii) changes in shopping at retail outlets: 3 modes (increase, decrease, unchanged); iii) changes in the purchase of takeaway and delivered food: 3 modes (increase, decrease, unchanged); iv) consumption of "bakery products": 3 modes (eliminated, introduced, unchanged); v) consumption of "ready meals": 3 modes (eliminated, introduced, unchanged); vi) consumption of alcohol: 3 modes (eliminated, introduced, unchanged); vii) food waste and domestic consumption (to date, do you believe that the domestic consumption of meals or food in general in your household has…?): 3 modes (increased, decreased, not changed).

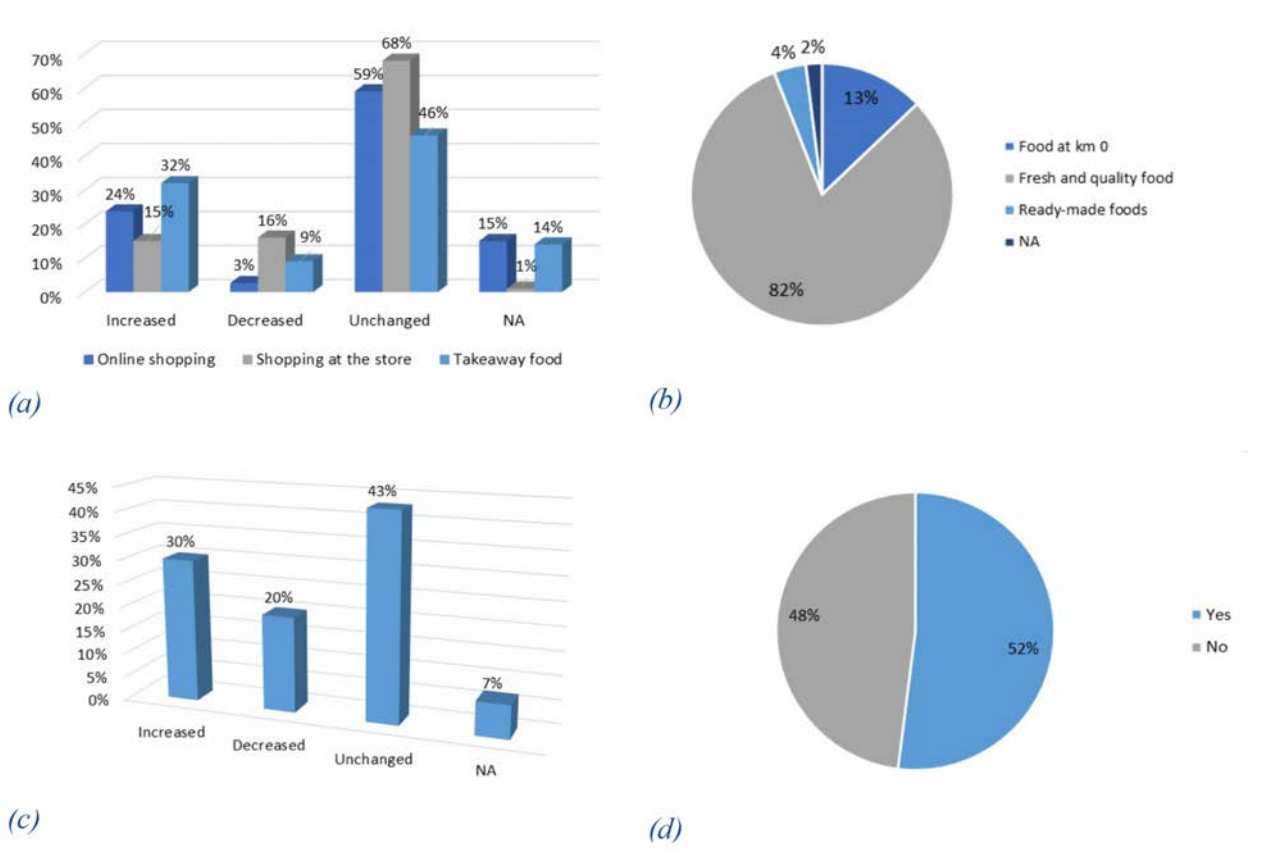

Figure 1. Percentage distribution of purchasing habits. NA, not available.

Table 3. Percentages of food-related worries.

Characteristics of foods	Quite worried (%)	Very worried (%)	Not very worried (%)	NA (no answers) (%)
Quality and freshness of the food	18	80	2	0
Presence of microplastics inside foods	32	59	8	1
Having an allergic reaction to foods or drinks	40	34	23	3
Hygiene conditions of food consumed outside the home	29	67	2	2
Not following a balanced and healthy diet	41	46	12	1
New viruses	40	39	17	4
Pollutants, such as mercury in fish	35	59	5	1
Bacteria that contaminate foods, such as salmonella in eggs and listeria in cheese	26	70	2	2
Pesticide residues in fruits, vegetables or cereals	32	60	6	2
Residual substances in meat, such as antibiotics or hormones	36	53	10	1

Supplementary/illustrative variable: sanitizing shopping helps reduce the risk of contagion, binomial variable (yes, no).

Typically, in MCA, the percentages of variance explained by the first factors are not very high, owing to the large number of variables and, consequently, the variability present in the data.

In our case (see Scree plot in Figure 2), the first two factors, F1 and F2, represent the optimal number of principal components to include in the analysis; the first two components provide an overall measure of the amount of variation captured relative to the total variation in the data. As regards the active variables, factor 1 was determined by the variables "decrease in takeaway purchases", "decrease in online shopping" and "introduction of alcohol", while factor 2 was determined by the variables "increased online shopping", "decreased in-store shopping" and "elimination of alcohol". Figure 3 identifies the variables most closely correlated to each dimension. The squared correlations between the variables and the dimensions are used as coordinates. To identify patterns of consumer behavior, we considered the additional variable "do you believe that sanitizing shopping reduces the risk of contagion?". Thus, we projected onto a graph the points representing respondents who sanitized their shopping and those who did not; the subjects who did not sanitize their shopping because they did not believe it reduced the risk of contagion were identified as group 1, while those who sanitized their shopping because they believed that this would reduce the risk were classified as group 2. Figure 4 shows that those individuals who did not change their behavior regarding online and takeaway shopping were also those who did not sanitize their shopping. By contrast, those who believed that sanitizing groceries reduced the risk of contagion also reduced their online and takeaway shopping and increased their in-store shopping.

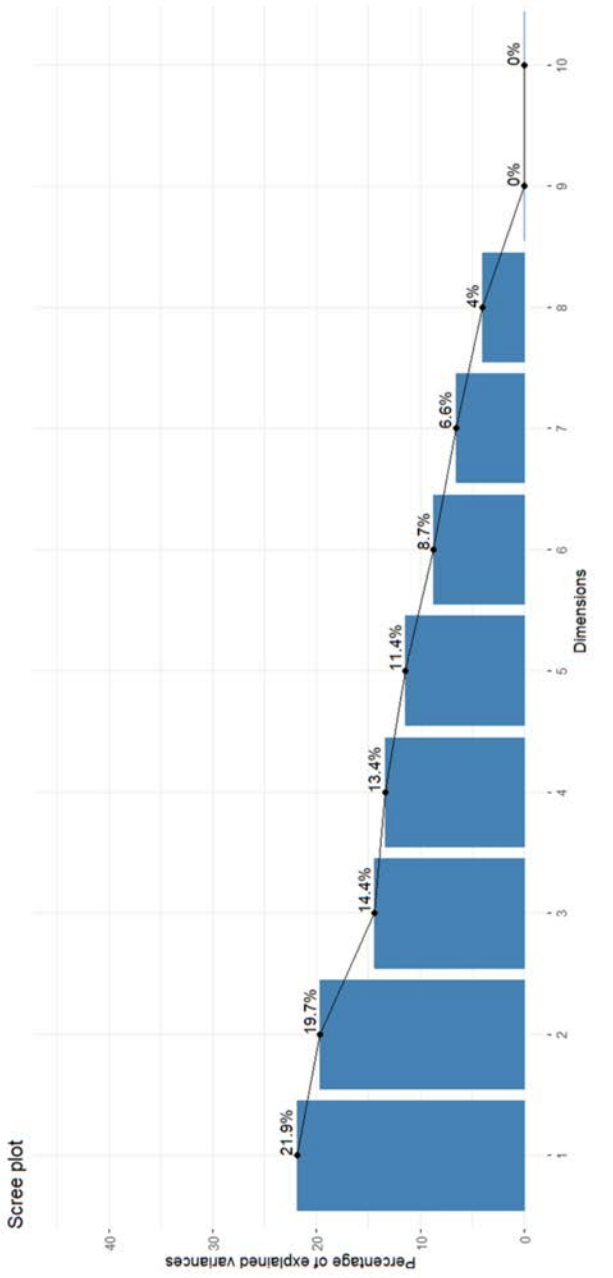

Figure 2. Multiple correspondence analysis principal factor Scree plot.

Discussion and Conclusions

This study investigated changes in food consumption habits during the COVID-19 pandemic and consumers' perceptions of the COVID-19 risk associated with nutrition. The implementation of this research was affected by the restrictions imposed by the pandemic. As the questionnaires could not be administered or distributed to schools in person, they were administered online. Consumers were a critical link in the food risk management chain during the COVID-19 pandemic. Indeed, awareness of possible risks and the adoption of correct practices protect personal and collective health. Various surveys/studies, mainly business-to-business, have found that changing patterns in consumer purchasing is one of the many phenomena caused and/or accelerated by the COVID-19 pandemic; this finding was confirmed by our respondents. If the change in purchasing patterns seen in the last few years persists, retailers, especially if they are small and little known, will need to adapt their commercial strategies to exploit the

Table 4. Percentages of different levels of risk perception.

	Quite close (%)	Very close (%)	Not close (%)	NA (no answers) (%)
Having financial difficulties	34	26	40	0
Being exposed to pollution that is harmful to my health	39	50	10	1
Contracting a serious illness	40	36	24	0
Being involved in an accident	45	15	38	2
Consuming food that is harmful to my health	42	34	23	1
Being a victim of a crime	25	10	62	3
Being a victim of terrorism	11	8	80	1

new marketing opportunities. Territorial coverage of our web survey extended to all Italian regions. The main limitation of this study was sample bias. The survey participants were chosen at random and recruited voluntarily. As a self-administered questionnaire, it was completed by unpaid volunteers. Therefore, only people driven by an interest in the topic participated in the survey (cf. self-selection of the sample). For example, highly educated individuals were overrepresented in our sample. However, as seen during the COVID-19 pandemic, online surveys can collect data from a distance, which is a distinct benefit when social distancing is necessary and face-to-face research is problematic (Janssen *et al*., 2021). Most of the participants in our study were women (70%) and people whose family unit consisted of more than two people. The obligation to stay at home obviously affected the consumption of ready-to-eat and preserved foods; indeed, question 12 ("how have your eating habits changed during the COVID-19 pandemic?") clearly shows that many people eliminated ready meals (31%), preserved fish (28%), frozen meat and offal (27%) and unpackaged bread (14%). This is in line with the findings of a previous survey (Di Renzo *et al.*, 2020). The balanced distribution between those who sanitized their shopping and those who did not consider sanitization to be a useful means of reducing the risk of contagion is interesting. This aspect was explored in depth using MCA, from which the following emerged: i) those who did not change their purchasing behavior with regard to online and takeaway methods were those who did not sanitize their shopping, as they probably believed that doing so did not influence the risk of contagion; ii) other respondents, who were worried about the pandemic, reduced their online and takeaway purchases and increased their in-store shopping; the same subjects believed that sanitizing their purchases could reduce the risk of contagion.

Thus, those who were most worried about the risk of contagion changed their behavior not only by sanitizing their purchases but also by reducing online shopping and delivery, believing that this could reduce the risk of contagion. Based on the risk perception that emerged, an information leaflet has been prepared. This will be distributed both online and during the training and information events organized by the IZSM. In addition, informative articles shared on the IZSM and ORSA websites and on the main social

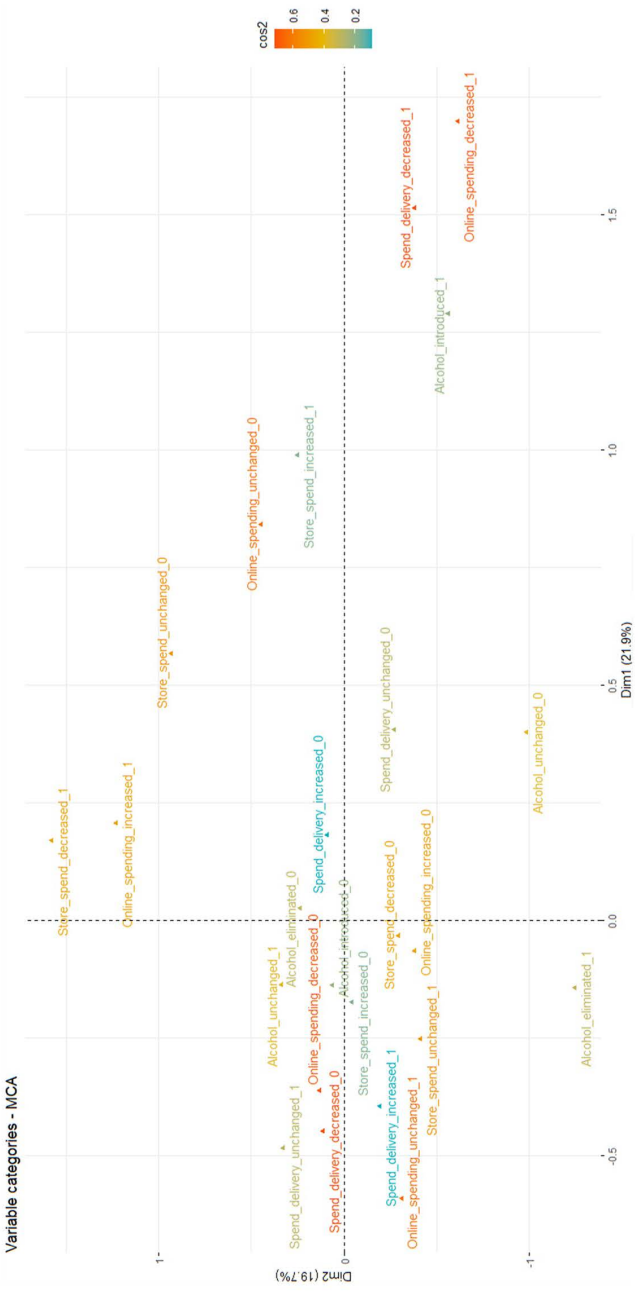

Figure 3. Biplot factors multiple correspondence analysis (MCA).

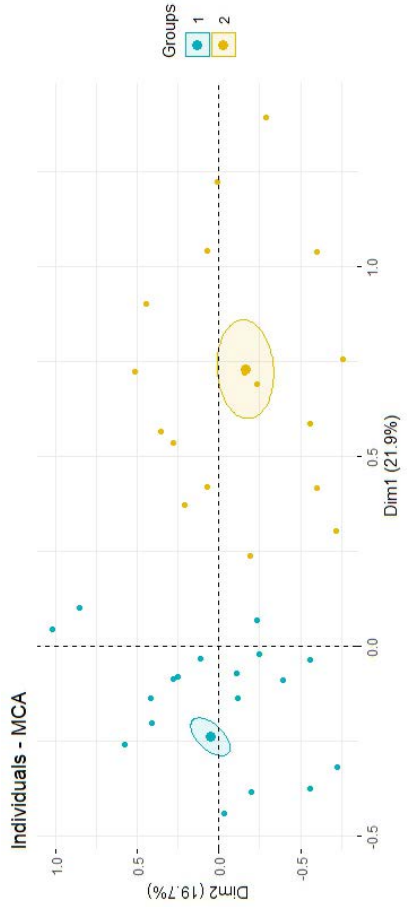

Figure 4. Biplot individuals multiple correspondence analysis (MCA).

platforms will be circulated, in order to improve consumer knowledge of the topic covered by the current research.

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