Assessment of Impact of COVID-19 Pandemic on Consumer Behavior Using the AHP Model

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Article

Assessment of Impact of COVID-19 Pandemic on Consumer Behavior Using the AHP Model

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Abstract: Consumer behavior is unpredictable. Sudden changes in consumer behavior, desires and needs change daily, which requires the inclusion of active marketing strategies to satisfy these needs. The impact of the COVID-19 pandemic has created significant disruptions in the market to which consumers have responded in a specific way. Our previous research on this topic [11], which included an analysis of various factors that influence consumer habits, was the basis for a new, more detailed analysis of the impact on individual consumption. The results of our previous research set psychological influence as a significant factor in consumer behavior. That is the main reason we put the impact of COVID-19 at the center of this research. The analysis was carried out on an existing sample of 559 respondents in the Republic of Croatia. The data obtained by the questionnaire were used to develop a hierarchical model. The Analytic Hierarchy Process (AHP) is a model used in making business decisions. During our research, we used it to rank individual influences on consumer buying habits due to the COVID-19 pandemic. The influences that were analyzed had a strong effect on consumer behavior.

Keywords: Consumer behavior; COVID-19 pandemic; consumer habits; Analytic Hierarchy Process

1. Introduction

The COVID-19 pandemic broke out in 2019, changing people's approach in all aspects of thinking, living and working, business organization, business process management, and market participation. [1]. The pandemic changed consumer behavior as well as approaches in marketing and sales. Some companies experienced a significant drop in turnover, while others used the crisis as a chance for success. Social distancing measures, movement restrictions, and quarantine were introduced almost everywhere. All this has had a significant impact on consumers, as well as their way of thinking and behaving.

In the context of the pandemic, the tourism and hospitality sector suffered the most losses while e-commerce experienced the greatest increase in its history The changes that occurred in consumer consciousness during the pandemic are not necessarily of a short-term nature [2]. They can be long-term in sales channels and distribution channels all the way to changes in shopping habits and the types of products purchased. Newly formed consumer habits in the future may continue through increased use of food delivery, online shopping, and virtual socializing.

It is necessary to investigate the phenomenon of consumer behavior change during a crisis, which includes changes in consumer preferences, purchasing channels, ways of thinking, changes in product consumption as well as new values that consumers emphasize [3]. We need to understand these changes so that companies can more easily prepare for similar future situations and more easily adapt to consumer needs. Considering the rapid change in consumer behavior in a short period, it shows the inherent fluidity in consumer behavior [4].

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Statista, 2023 [5] highlights that certain product categories, such as household necessities or food products, are likely to experience greater changes in consumption than others, such as luxury goods. In terms of luxury goods, crises have a minimal impact on their purchase, while the COVID-19 pandemic could change this dynamic [6]. There is also an expected increase in the purchase of certain medical products, but there is also a question of access to these products [1]. Many individuals have been stockpiling products due to fears of shortages in the market [2]. The pandemic has driven digitalization like never before and has influenced the creation of different consumer habits [7]. The prices of some products have significantly increased due to the pandemic, while the prices of others have fallen, depending on the product and industry [8]. Reduced production capacities and logistical problems have led to delivery delays as well as shortages of certain products in the market [9].

Consumer behavior is unpredictable, however, the factors that influence their behavior are social, cultural, personal, and psychological. These need to be analyzed to try to predict consumer behavior in the future due to natural disasters, pandemics, wars, crises and non-verbal communication with consumers sometimes plays a key role [10].

This study is a continuation of the research [11] where the influence of certain factors on consumer behavior was investigated. The research showed a significant impact of psychological factors as well as a long-term change in purchasing habits. By expanding the mentioned study, the extent of the impact of the COVID-19 pandemic on consumer buying habits will be determined, and a model of predictable consumer behavior will be created in the event of similar crisis situations. This research analyzes scientific literature related to consumer behavior with an emphasis on the COVID-19 pandemic. The aim of the study is to determine the impact the COVID-19 pandemic had on consumer behavior and their purchasing habits.

To investigate this, extensive desk research was conducted, as well as the implementation of a survey questionnaire which was later used through the Analytic Hierarchy Process method.

When analyzing multi-criteria decision-making, the AHP method holds a special place. It is first mentioned by its creator Thomas L. Saaty, where the AHP method is detailed and accurately described [12–14]. The AHP model is a structured technique used for managing, organizing, and analyzing complex decisions, involving mathematics and psychology [15]. It is applied in making group decisions in various areas of operation and action within companies [16]. AHP as a tool that helps in making key decisions has proven to be a great help to the private and public sectors in business and daily work. Decidophobia is the fear of making decisions, and the role of the AHP model is to facilitate these decisions. It's not just a decision but also a guide to solving a specific problem. The impact of individual factors is very difficult to predict, and they often have a stochastic nature, requiring more complex processes in making business decisions. Therefore, we will use the AHP method to analyze the impact on consumer habits due to the influence of psychological factors with an emphasis on the COVID-19 pandemic [11]. To implement the AHP model, a hierarchical approach to problem-solving is needed, from defining and analyzing it, proposing possible solution variants, and choosing one of the variants. [17]. Such an approach will enable us to assess the impacts on consumer purchasing due to the COVID-19 pandemic. Entrepreneurs and decision-makers in other sectors will have opportunities available in approaching consumer habits and adapt their marketing activities in time when crisis situations occur (pandemics, wars, economic and financial crises, natural disasters) more easily. Every crisis should be seen as an opportunity for success, and it's here where adaptability and speed in decision-making will come into play. Using the AHP method, this study aims to determine the market influences that have affected the instability of supply and demand for products and to rank the most important ones. As already mentioned, this research is an extension of the previous one, and the sample of same 559 respondents from the Republic of Croatia was used to obtain more credible data.

This research includes: the theoretical framework of consumer buying habits and the impact of the COVID-19 pandemic on their behavior, providing hypotheses and the analytic hierarchy process as a multi-criteria decision-making method, methods used in the research, results and discussion, and the conclusions of the paper.

1.1. Problem Statement

This research aims to define consumer behavior in the Republic of Croatia as a reaction to psychological influences with an emphasis on the COVID-19 pandemic and how they are behaving during it while shopping. Since the COVID-19 pandemic is a relatively new phenomenon, this type of research is crucial in understanding consumer psychology.

1.2. Significance of the Study

Consumer behavior is activated due to various influences and is often unpredictable. Everyone is different, and these stimuli affect each of them differently. For marketing professionals and companies, it is essential to understand how individuals behave in times of wars, pandemics, natural disasters, and other market disruptions to timely offer the product that the market demands. If the changes in consumer buying habits are similar due to these influences, it will be much easier to plan for satisfying consumer needs.

Consumer behavior is important for understanding market trends and predicting future changes. The pandemic has affected all spheres of life, people think and behave differently and the world is no longer the same. By investigating changes in consumer behavior during the pandemic, we can better understand how consumers adapt to crisis situations and how they will behave in similar situations in the future. This research will also help companies to better understand how consumer behavior changes in crisis situations, enabling them to better prepare and adapt. This can affect their marketing, sales, supply chain strategies, and many other aspects of their business. It can be useful for policymakers in formulating strategies and interventions for crisis management. This could include policies promoting economic recovery, consumer protection measures, and other policies related to consumer behavior.

The research can contribute to the development of models that can predict how consumer behavior will change in future crises. These models can be useful for companies, policymakers, and academic researchers.

By studying changes in consumer behavior during and after the pandemic, this study can provide insights into the long-term impacts of the pandemic on society and the economy. These long-term impacts can have significant consequences for everyone, from individual companies to the global economy.

1.3. Literature Review

In today's times of great changes, with a fast-paced life, various information and opportunities are available to consumers. With the development of technology and the internet, emphasizing social networks, consumers are daily exposed to a variety of different stimuli that trigger their senses. Creating a need is a prerequisite for initiating a purchase action. The COVID-19 pandemic has changed the world, changed people, and changed the way of thinking. Like any other crisis, consumers have a similar pattern of behavior. In times of any crisis, the resilience of the economy and economy is important, and the goal is to maintain consumption at the desired level. In communication with consumers, IT and other communication tools were key to building resilience. [18]

When we talk about consumers themselves, their preferences have changed significantly. Ghodsi et al, 2022 [19] found that consumers behavior travel within the towns affects their attitudes towards online shopping, and that people who are aware of the dangers of the pandemic shop online more frequently. Movement restrictions and distancing of people have significantly affected consumers who had to learn to improvise. Consequently, consumers have brought action home by accepting online technologies, from learning, working, to entertainment [20]. Difficulties in finding simple consumer products, or the inability to go shopping in stores, have developed online shopping skills exploiting the delivery of food and other products. [21]

The impact of the COVID-19 pandemic has spurred rapid growth in the use of digital technologies and online shopping, and even the most skeptical have accepted the changes that have

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occurred [22–30]. Older people no longer refuse to purchase via mobile methods, and many online shopping activities have increased [31]. In his research, Milaković, 2021 [32] presents studies showing that consumer adaptability to online shopping directs the relationship between consumer resilience and shopping satisfaction. The study of Hartono et al, 2021 [33] shows that consumers who are more rational and economical and care more about health are more willing to accept online shopping. Younger consumers who are prone to apply all variables to adjust their attitudes and behaviors when shopping. While older consumers were more rational and economical, as well as more preserved their health and were more ready to help others affected by the pandemic. [33] The conclusion of Hansson et al, 2022 [34] is that younger consumers will predominantly continue to shop online, while the older population will continue to shop both online and physically in the post-pandemic period.

Tyrväinen and Karjaluoto, 2022 [35] prove that consumers did not buy products online during the pandemic because they have a positive attitude towards such type of shopping, but because they were forced to shop online. In their research, Moorthy et al, 2022 argue that ease of use and situational factors had a significant impact on accepting online shopping during the pandemic. [36]. The descriptive analysis of the behavior of Meiser et al, 2023 [37] shows that when choosing a way of shopping, respondents prefer physical shopping in relation to online, whether it is a pandemic or non-pandemic period.

Consumers who find it less complex to buy food online are more likely to be satisfied with this experience. Respondents with higher education, who are familiar with online food shopping, consider that online shopping is not very complex. [38]. Topolko Herceg, 2021 [39] emphasizes that online shopping with delivery will probably continue even after the pandemic because consumers will remember online sellers who made their quarantine easier. The analysis by Diaz-Gutierrez et al, 2023 [40] showed that most people plan to return to their pre-pandemic shopping behaviors in stores but will continue to shop online. The results also showed that the reduction of in-store shopping is much less (one-third to half) than the increase in online shopping.

The findings of the studies by Soares et al, 2023, Truong and Truong, 2022, and Sachdeva, 2022 indicate that the COVID-19 pandemic affects online shopping behavior, as people fear infection when going for physical shopping and that online shopping is the best solution. Also, going to stores for a certain number of consumers leads to anxiety and fear of infection, especially by touching objects and doubting hygiene protocols [41–43]. When people have enough knowledge about COVID-19, they actively carry out self-protection measures, which leads to more online shopping. [44,45]

COVID-19 has also accelerated the digitization processes of supply chains and distribution channels [46]. However, regardless of the acceleration of digitization, during the pandemic there was a clear problem in the distribution of certain products which led to their shortage in the market [47]. On the other hand, Aday and Aday, 2020 [48] note that in their research they did not notice major problems in supply chains, but that further development of the pandemic remains unclear how this will develop. The analysis by Alsuwailem et al, 2021 [49] emphasizes that the COVID-19 pandemic has affected demand and thus caused a lack of transport and has negatively affected supply chains. It is visible that the sensitivity of distribution is greater at the beginning of the pandemic while later it stabilizes and starts to function normally [50]. Due to this, resilience in distribution channels is extremely important in the event of market crises. [51,52].

During the COVID-19 pandemic, people were less active due to working from home, movement restrictions, and fear of infection. The study by Ráthonyi et al, 2021 [53] shows that measures had a smaller impact on the psyche of those who were employed but had to work from home compared to the unemployed. Many experienced anxieties due to movement restrictions and reduced work activity [54,55]. To reduce anxiety and fear, people began to connect more through social networks and media, thus reducing the trauma caused by social distancing [56]. Fearing infection, a significant number of people opted for private transport over public or chose non-motorized transport, which also influenced their shopping habits. [57]

When the pandemic started, many of people was buying products in panic due to fear of shortages, creating unnecessary stockpiles, which was particularly visible in the first weeks after the pandemic was declared [58–68]. The problem of panic buying is most evident in everyday

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consumption products such as toilet paper and similar items [69–71]. After a turbulent start, the market stabilized and people realized that there would be no shortage of products, so they returned to usual shopping habits [72].

The negative impact on the economy of individual countries due to the COVID-19 pandemic should not be overlooked. In their research, Labadze and Sraieb, 2023 [73] point out that the pandemic negatively affected the profitability of companies, especially in countries with strict pandemic policies, and those financial results varied by sectors. Here, communication between companies, the state, and consumers played a major role. Traders needed to clearly emphasize that their priority is the protection and health of consumers [74–76]. In their research, Ikram et al, 2022 emphasize the strong impact of the pandemic on the export of goods and services, logistical performance, ISO 9001 and ISO 14001 certificates [77]. The tourism sector, due to social distancing and travel restrictions, as well as other small business sectors, also felt a strong negative impact [78,79]. On the other hand, consumers reduced their consumption due to job loss or fear of losing it [80]. The option of online shopping somewhat mitigated the overall impact of the consumption shock, thus increasing the resilience of the economy [81,82].

During every crisis, there are changes in purchasing habits and quantities of products purchased by consumers, which is clearly visible during the COVID-19 pandemic [83,84]. In their research, Rayburn et al, 2021 [85] and Park et al, 2021 [86] highlight that during the pandemic, customers began to question their buying decisions and changed their behavior patterns. They started buying local brands [87,88]. Kotler, 2020 [89] noted that the period of pandemic (deprivation and anxiety) is leading to new consumer attitudes that is changing the nature of today's capitalism. Citizens are re-examining what they consume, how much they consume, and how the pandemic has affected class and inequality issues. In Denmark, Germany, and Slovenia, food consumption is decreasing due to the pandemic [90], while in China, food consumption is increasing [91]. Due to distribution problems and a shortage of products on the market, emphasis should also be placed on the financial availability of products [92]. It is noticeable that consumers are changing their preferences when shopping and that they cook more at home and eat out less [93,94]. Also, consumers feel the greatest discomfort during the pandemic if they physically go shopping [95].

During the COVID-19 pandemic, consumers' eating habits have also changed. In their study, Renzo et al, 2020 [96] highlight a visible perception of weight gain in 48.6% of the Italian population. A large part of the population ate unhealthy due to lockdown and reduced outdoor activities, leading to increased consumption of snacks and alcohol [97–101]. On the other hand, health awareness was higher for consumers who lost their jobs or had lower incomes [102]. Regarding the purchase of certain products, consumers in the Eurozone are more pessimistic compared to respondents in the US and China [103]. In addition to promoting and increasing product availability, innovations in the food sector and emotions play a significant role in overcoming the crisis [104,105].

1.4. Research objectives and hypothesis

When there are disruptions and crises in the market, it is almost impossible to control consumer behavior. The challenge (existing problem) is that it is very difficult to monitor consumer behavior especially in the times of crisis. We determine one (1) main impact that influence consumer behavior in the time of COVID-19 pandemic: psychological factors.

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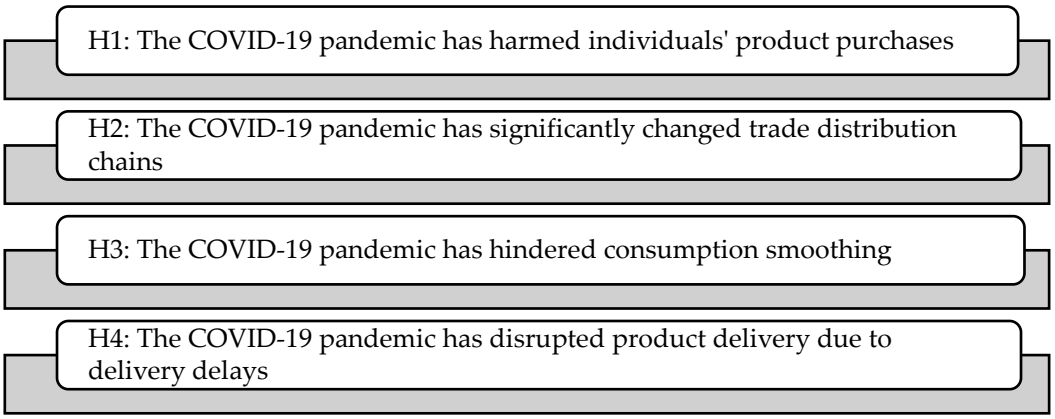

Figure 1. Hypotheses of the study.

In this research, we set four (4) hypotheses to test what influences was caused pandemic of COVID-19 on consumer behavior and what buying habits changed. For this purpose, five hypotheses were tested: H1: The COVID-19 pandemic has harmed individuals' product purchases; H2: The COVID-19 pandemic has significantly changed trade distribution chains; H3: The COVID-19 pandemic has hindered consumption smoothing; H4: The COVID-19 pandemic has disrupted product delivery due to delivery delays.

2. Materials and Methods

The research methodology is significant as it provides a structured and organized approach to proving the set hypotheses. It allows other authors to replicate the research results so that they can confirm or deny them. It also gives information on how data were collected and analyzed to determine their consistency and reliability. It is very important that the research is transparent and not biased. In this research, a comprehensive comparison was made with other authors of similar research to come to a comprehensive conclusion.

The methodology used in this study involves both primary and secondary research based on which specific conclusions were drawn. By reviewing scientific literature (studies, papers, textbooks/books, statistical data, analyses), secondary data was obtained. Furthermore, a survey questionnaire was conducted as a continuation and upgrade of the previously conducted research [11], and the obtained data was used through the AHP method. To improve the quality of the research, assistance from artificial intelligence tools was utilized to a minor extent.

A survey was conducted in the Republic of Croatia in 2023, where a questionnaire was sent to 1127 individuals who were drawn from the researcher's private database by random selection. This database consisted of 2000 registered active users of social networks, email databases, and other research databases. A unique number was assigned randomly using an online random number generator to get 1127 respondents to whom we later sent the questionnaire. Out of the mentioned sample, 559 respondents properly (anonymously) filled out the survey questionnaire, and these respondents served as a further basis for the continuation of the research. In this research, a well-established methodology will contribute to the accuracy and credibility of the results related to the impact of the COVID-19 pandemic on consumer behavior. It helps understand how the COVID-19 pandemic has affected various types of products, allows detecting changes in consumption of luxury and medical products, provides insight into trends of product stockpiling, and assesses changes in the use of online distribution channels during the pandemic. Therefore, a high-quality methodology represents the foundation for achieving reliable and relevant research results.

The use of random sampling for the consumer sample is an effective approach for this research due to several reasons. It guarantees that every consumer in the population has an equal probability of being selected. This aspect is crucial as it contributes to ensuring that the sample is a good representation of the entire population, thereby strengthening the validity of the conclusions drawn from the research. Random selection reduces bias. Without random selection, there's a risk that the

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researcher, either intentionally or unintentionally, may select a sample that is biased in some way. This bias can skew the results of the research and lead to inaccurate conclusions. Random selection facilitates statistical analysis. Since each consumer had an equal chance of being selected, researchers can use inferential statistical methods to draw conclusions about the population based on the sample. When random selection is used, other researchers can repeat the research using the same selection method. This allows for the verification of results and the reliability of the research. With random selection, every consumer has an equal opportunity to be chosen to participate in the study, which may reduce ethical problems associated with participant selection. Should the sample accurately represent the whole population, the findings derived from this sample can be confidently generalized to the entire population. Random sample selection can reveal interesting patterns that might not have been discovered with targeted participant selection.

The survey questionnaire was conducted online (Google forms). The questionnaire was sent to respondents via social networks, mobile applications (Viber and WhatsApp) and via email addresses.

In Table 1, more women than men participated in the survey. Respondents from 18-45 years old were represented in larger numbers than older respondents. Most respondents are employed and have a marital partner, so here we can talk about some life and financial stability of the respondents. Many respondents have monthly financial income above 800 euros and above 1099 euros. The participants involved in the survey were chosen randomly without any intent to guide or influence their perspectives. Given that consumer research is an all-encompassing process and considering that the entire population experienced direct or indirect effects on their behavior owing to the COVID-19 pandemic, respondents were incorporated from a wide-ranging research area.

Table 1. Demographic information of the respondents.

Sex	No
Male	201
Female	358
Age range	No
18 to 25	134
26 to 35	117
36 to 45	173
46 to 55	79
More than 56	56
Occupation or Job status	No
Jobless	148
Gainfully employed	411
Relationship status	No
Not married	241
Married	318
Monthly earnings	No
Max 499 euro	127
500 to 799 euro	83
800 to 1099 euro	153
More than 1099 euro	196

The implementation of the survey is shown in the following picture (Figure 2), where the values from our previous analysis of the impact of various effects on consumer habits are shown [11]. The final values indicate the priority influence of personal factors on consumer habits. However, we based the analysis on the priority vectors of alternatives according to the criteria [11]. Although social media carried the most weight, in this analysis we decided to assess the impact of the COVID-19 pandemic

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for two reasons. First, because of the attractiveness of the topic. Second, the priority vectors for the variants according to the social network and the COVID-19 criteria are the same and the largest of the others. Through a detailed analysis of the specified priority vectors of both criteria, we observed the impact of COVID-19 on the growth of the use of social networks, which was in favor of the greater weight of social networks that we see in Figure 2.

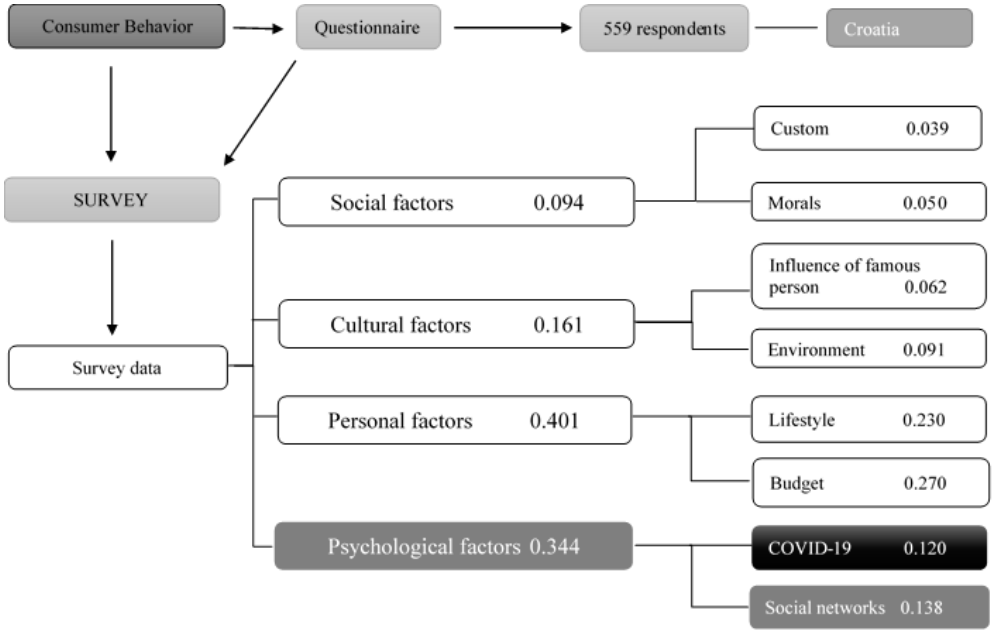

Figure 2. Survey implementation scheme [11].

All the above materials show the different impacts of the Covid-19 pandemic on the consumption of individuals. The author's task is to classify these influences into four groups. The aim is to estimate the isolated impact of COVID-19 on individual consumption. We will use a multi-criteria decision-making approach (MCDA) to make the right decision [106,107]. The best tool for multiple decision-making is the AHP method. Although the AHP method is burdened with subjective evaluation of criteria and alternatives, it has been widely used for decades thanks to its numerous possibilities and adaptability to different problems. Šostar and Ristanović, 2023 [11] highlight numerous advantages of the AHP method. First, it significantly speeds up the decision-making process. According to them, the AHP method stands out for effective decisions. Moreover, its logical approach to problem structuring is highly versatile and practical. It provides a means for quantifying the relationship between the goal, criteria, and alternatives. The instruments of the AHP method have demonstrated their efficacy in attributing pairs of weights and prioritizing criteria, aiding in making an informed decision. We will use some of these tools to estimate the impacts of COVID-19 on individuals' spending by calculating their weight and then ranking them by size.

Multi-criteria decision-making (MCDM) is a method used to assess multiple contrasting criteria in order to identify the best choice among various alternatives, with all the constraints, preferences, and priorities faced by decision-makers [108]. Wallenius et al, 2008; Salavati et al, 2016; Li et al, 2016 [109–111] discussed recent accomplishments in the field of multi-criteria decision making and utility theory, as well as the ways and possibilities of using the AHP method in practice. The AHP method has been widely used in the research of many authors [112–122] due to its ability to make the best decision while reducing the complexity of the decisions themselves.

The aim of this paper is to determine consumer behavior and changes in consumer purchasing habits because of the COVID-19 pandemic using the AHP method. Therefore, it is necessary to highlight authors who have actively used the same method to address issues in marketing [123–136].

Jurik, 2020 [17] views the decision-making process as a chronological series of activities from defining the problem to choosing an alternative solution according to certain criteria. This prompted the authors to create a flowchart (Figure 3) for assessing the influence of COVID-19 indicators on

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individual consumption, highlighting important steps, from the selection of indicators to their consolidation [137,138]. Each step will be explained below.

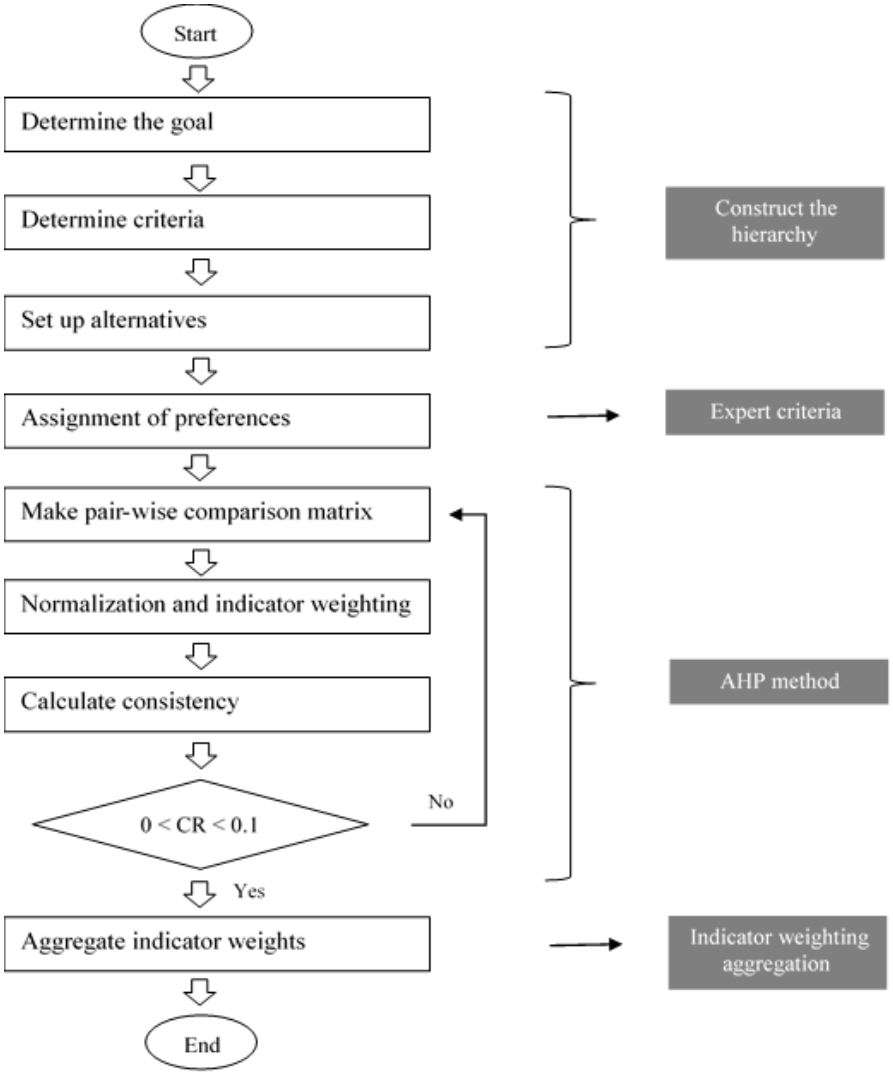

Figure 3. The AHP algorithm.

For the phase of constructing the hierarchy, it is necessary to identify the goal, criteria, and alternatives that will be used to quantify the ultimate impacts of COVID-19. All these elements of the hierarchy must be defined adequately from a consumption perspective, supporting decision-making through a simplified form of a complex phenomenon. Why is it important that they are adequately defined? All of them in the preference assignment phase become input data for expert criteria that define a pairwise comparison between all of them. The preference allocation process is based on a survey of citizens in Croatia. The sample size was 559 surveys, and data collection was based on online survey.

After constructing the hierarchy and obtaining the performance, expert criteria define the importance of elements of the hierarchy using Saaty's preference scale [14]. This scale contains nine qualifications and shows the level of importance between the elements of the hierarchy, assigning weights to each of them through the AHP method.

The basic task of the experts (as in the previous analysis by Šostar and Ristanović, 2023) [11] is to ensure the logical consistency of the different levels of the hierarchy, which implies compliance with the criterion of transitivity of preferences. So, if COVID-19 remains a priority for psychological effects, and the topic of psychological effects determines consumer habits, then priority must be given to COVID-19 in determining consumer habits. The same analysis, with a consistency test, is used for the other elements in the hierarchical structure.

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In the AHP stage, preferences are established following a pairwise comparison format. Pairwise comparisons are performed for each element within the hierarchical structure. When pairwise comparisons are made for N elements, a judgment matrix (A) is formed. Each element of the matrix (a_{ij}) is created by comparing the row elements A_i with the corresponding column elements A_j such that $A = (a_{ij})$, where $i = 1, 2, \ldots, N$ and $j = 1, 2, \ldots, N$ represent the number of criteria. The main diagonal of matrix A is equal to 1 ($a_{ii} = 1$ or $a_{jj} = 1$). Below him appear the inverse ratings of those above him. According to Saaty's scale, above the diagonal of the matrix A there are values from 1 to 9, and below them are the corresponding inverse values [137,138].

Londoño-Pineda et al, 2021 [137] shows that in the next two steps a normalized matrix is created, with weights for each criterion (Wi). And that, by dividing each value of the matrix by the sum of that column (equation 1), and then the rows of all standardized values (sa_{ij}) are summed and divided by the number of criteria (equation 2).

$$sa_{ij} = \frac{a_{ij}}{\sum_{i=1}^{N} a_{ij}} \; \forall j \in N \tag{1}$$

$$W_i = \frac{\sum_{j=1}^{N} sa_{ij}}{N} \; \forall i \in N \tag{2}$$

The new judgment matrix A has a new problem (equation 3): a problem of vectors and eigenvalues [139]:

$$A * \omega = \lambda * \omega, \quad {}_{e^T=1} \tag{3}$$

, where A is the reciprocal matrix of pairwise comparisons of the dimension nxn, ω is the eigenvector that represents the ranking or priority order, λ is the maximum eigenvalue representing a measure of the consistency of judgments, and e is the unit vector [137,138].

The final step in this phase involves calculating consistency. According to Saaty, 1990 [140], the consistency coefficient (CR) is the ratio between the consistency index (CI) and the random index (RI), and is shown in Equation 4. Calculated values of the RI are presented in the Table 2.

$$CR = \frac{CI}{RI} \tag{4}$$

Table 2. The value of the random index (RI) [140].

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RI	0	0	0.58	0.89	1.11	1.25	1.35	1.40	1.45	1.49	1.51	1.48	1.56	1.57

Equation 5 is used for the consistency index

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{5}$$

, where λmax is the maximum eigenvalue (obtained by multiplying the vector of total sums from the matrix of paired comparisons with the vector of weighted values from the normalized matrix), and n represents the number of parameters.

If CR < 0.10, there is consistency, while if CR > 0.10 consistency does not exist, then the entire process (preference assignment and pairwise comparisons) needs to be repeated to obtain a reliable measurement model of the elements of the hierarchical matrix.

In the last stage, aggregation of weights, the weight of each criterion is calculated by adding the weights of the assigned alternatives, so that the sum is equal to 1.

Solving a set goal or problem through several iterations of the hierarchical AHP algorithm increases the quality and efficiency of decisions [11,140].

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Summarizing all the positive experiences the authors had through their analysis and research, AHP is one of the most preferred methods in multiple decision-making. Perhaps we could best present the advantages of the AHP model by considering Saaty's features of the AHP model [141]:

- Unity.
- Complexity.
- Interdependence.
- Hierarchic structure.
- Measurement.
- Consistency.
- Synthesis.
- Tradeoffs.
- Judgement and Consensus.
- Process Repetition.

2.1. Modelling the AHP hierarchic structure

The AHP method facilitates the decision-making process and implies the analysis of decision-making problems through several hierarchical levels. Basically, the AHP hierarchical structure starts by defining the objective, then the criteria are ranked, and finally, one or more alternatives are selected from the defined set of alternatives. This hierarchical structure represents a logical structure of interconnected components. The principle of logical consistency encompasses assessing the degree of coherence between the goal, criteria, and variants. Initially, the priority of the criteria based on the specific problem is determined; following this, the priority of alternatives for the stipulated criteria is computed; ultimately, the priorities of alternatives according to the defined problem are determined. [139]

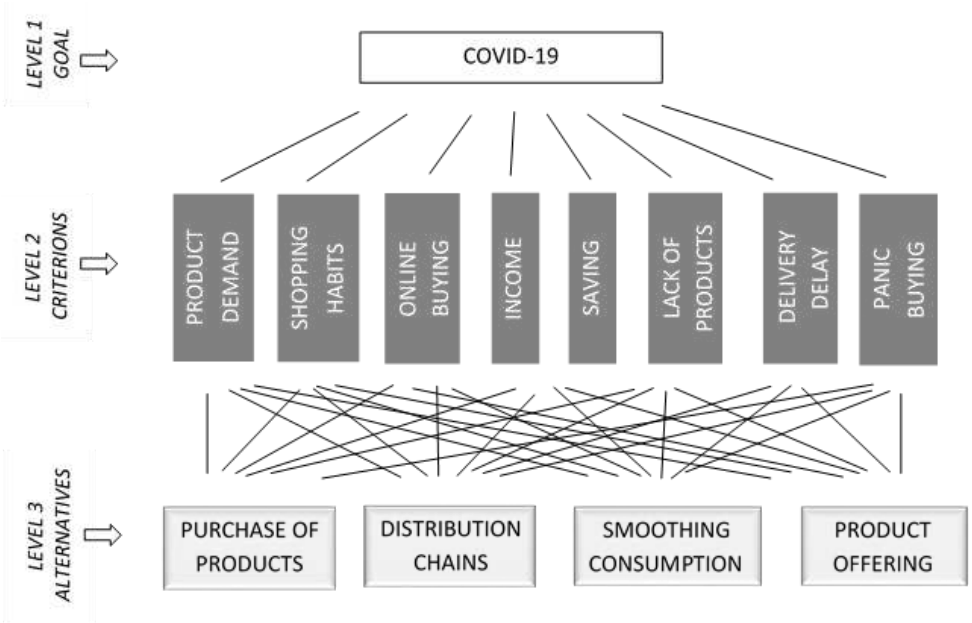

Figure 4. The Analytical Hierarchy Process model – distribution channel objectives and actions hierarchy.

In our example, at the top of the hierarchical structure, there is a problem that consumers face. This is the goal of our analysis: to assess how COVID-19 affects individual consumption. Setting the problem of the AHP method, criteria are defined to identify the problem, i.e., COVID-19. The following criteria were singled out: C1 – Product Demand, C2 – Consumer Habits, C3 – Online Buying, C4 – Income, C5 – Saving, C6 – Lack of Products, C7 – Delivery Delay, C8 – Panic Buying. The results are obtained from several predetermined alternatives that represent options for solving

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the problem: A1 – Product Consumption, A2 – Distribution Chains, A3 – Smoothing Consumption, and A4 – Product Supply. The final decision must be the best solution for the defined problem, and it is made based on the highest-ranking alternative.

3. Results and discussion

Data processing of the survey questionnaire allowed us to expand the analysis of var-ious factors of consumer habits [11] to the impact analysis of only one criterion, the COVID-19 pandemic, on individual consumption. The selection of the in-fluence of this criterion put us in a position to create a new hierarchical structure of the AHP model. The new problem/objective of analysis becomes COVID-19 taking the place of the previous one - consumer habits. There are two reasons why we decided to take this step. The first is that the topics of COVID-19 are always current and represent a good basis for decision-making in crisis. The second reason is that in the initial assessment of the im-pact of the effects, viewed through the evaluation of the criteria for the selection of alternatives, the dominant criterion was COVID-19. On the other hand, a well-designed survey and presentation of the problem during the pandemic period gave us a good basis for various analyses. The results allowed us to present the perspectives of consumer access to the market and timely adaptation in new crisis conditions. Also, the results gave us the basis for understanding the behavior of individual consumers and the continuation of the re-search in that direction.

Figure 5 shows us that during the COVID-19 pandemic, the decision to reduce the purchase of luxury products was most prevalent, while the reduction in purchasing health-related products and daily consumption products was minimal. It is also visible that many respondents did not reduce their purchases of any of the mentioned product groups. During the pandemic, many people experienced job loss or wage reductions, leading to decreased disposable income. As a result, they might have opted to save money and cut back on non-essential purchases, like luxury items. The pandemic shifted consumer priorities towards health and wellness. People were more likely to spend on health and hygiene products, food and groceries, and less on luxury items. With social distancing measures and lockdowns in place, consumers spent more time at home, reducing the need for luxury items such as designer clothing, accessories, or high-end electronics. The pandemic increased the focus on health and wellness, leading to a surge in purchases of health-related products such as sanitizers, masks, vitamins, etc. Daily consumption products like food and hygiene products are essential, and their demand generally remains stable, regardless of the economic situation. The fact that many respondents did not reduce their purchases in any of the product groups could be attributed to various factors such as financial stability, the nature of their job (some sectors were less affected by the pandemic), or personal beliefs and habits. It's important to note that consumer behavior is multifaceted and influenced by a complex set of factors that could include socio-demographics, psychological factors, and individual circumstances.

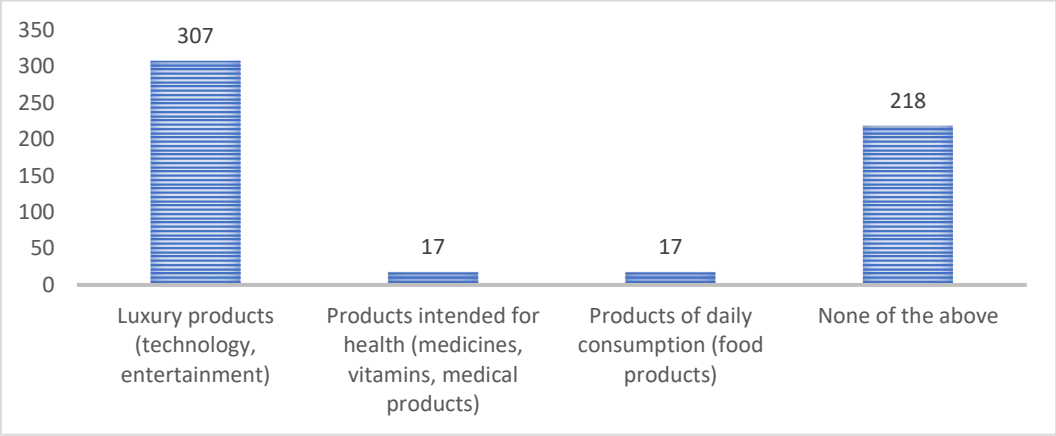

Figure 5. Reduction in product purchases during the COVID-19 pandemic.

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Figure 6 shows that during the COVID-19 pandemic, there was a significant increase in the purchase of health-related products and everyday consumption products, while the increase in the purchase of luxury products was minimal. It is also visible that many respondents did not increase their purchases in any of the mentioned product groups. During times of crisis or uncertainty, consumers tend to focus on securing goods that are essential for survival. This includes food, medical supplies, and other items used in daily life. Hence, an increase in the purchase of health-related products and everyday consumption products can be seen. The pandemic has had severe economic impacts, leading to job losses and reduced income for many people. This uncertainty can cause consumers to cut back on non-essential spending, such as luxury goods. As a result, the purchase of luxury products is minimal. Health has become a significant concern during the COVID-19 pandemic. As a result, consumers may be more likely to invest in health-related products to protect themselves and their families, explaining the increase in the purchase of these products. Due to the enforcement of lockdown measures, individuals have been spending more time at home, which has resulted in a surge in the usage of daily commodities. The COVID-19 pandemic has notably expedited the expansion of e-commerce, as numerous consumers have shifted towards online shopping in adherence to social distancing regulations. This could explain why many respondents did not increase their purchases in any of the mentioned product groups, as they might have switched to online shopping.

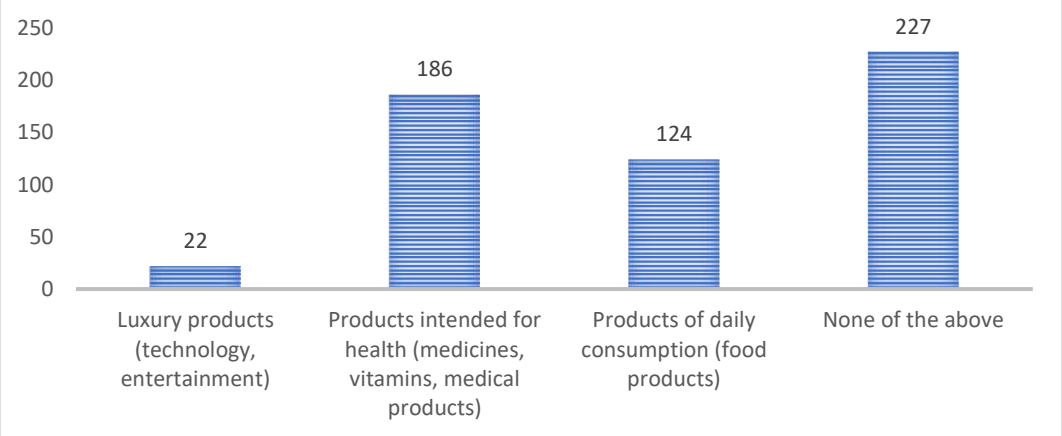

Figure 6. Increase in product purchases during the COVID-19 pandemic.

Figure 7 shows that during the COVID-19 pandemic, online shopping as a distribution channel increased, while physical shopping increased only in a negligible number of cases. Also, almost half of the respondents did not change their shopping method. Many people turned to online shopping to minimize their potential exposure to the virus in crowded places such as stores and markets. Online shopping offers the convenience of home delivery, a broader range of product options, and the ability to shop at any time, without the need to commute or queue. Many countries imposed lockdowns and social distancing measures that limited the operations of physical stores and restricted people's movement, making online shopping a more feasible option. The pandemic has also resulted in an overall increase in internet usage due to remote work and online education, making people more accustomed to using digital platforms for various purposes, including shopping.

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Figure 7. Increase in the use of purchasing and distribution channels during the COVID-19 pandemic.

As we can see in Figure 8, it is evident that the monthly income of the respondents remained stable and that the COVID-19 pandemic did not affect their income. The respondents might have been in industries or job roles that were not heavily affected by the pandemic. Certain sectors like technology, healthcare, and essential goods saw stability or even growth during the pandemic. Many governments implemented measures such as stimulus checks, unemployment benefits, and other financial aid programs to support their citizens during the pandemic. These measures could have helped maintain the income levels of the respondents. The transition to remote work allowed many businesses to continue operating during the pandemic, which ensured that their employees continued to earn their usual income. The respondents may have had sufficient savings or investments to maintain their income level during the pandemic.

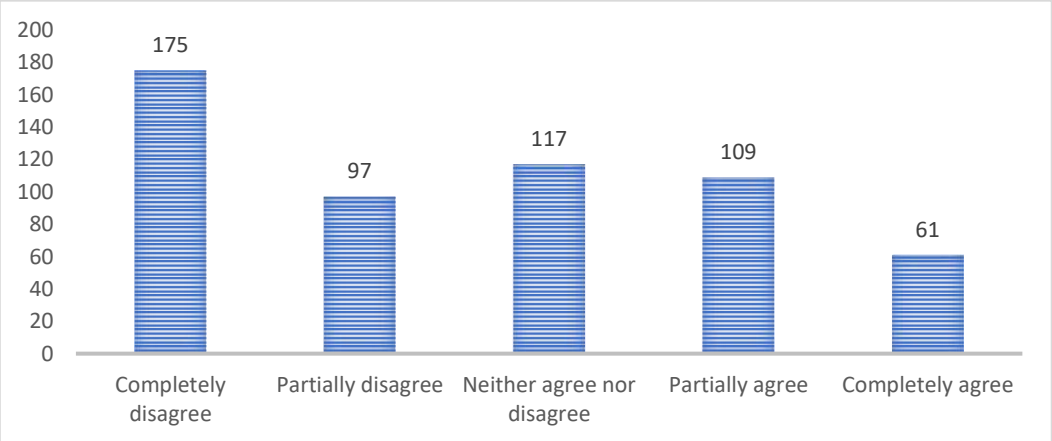

Figure 8. The COVID-19 pandemic has affected my monthly income?

It is also important to emphasize that the research shows that buying habits have not significantly changed and that respondents did not stockpile products due to the media's "bombardment" of the public with attempts to create a false sense of panic. It is apparent that the stockpiling of products by individuals was only isolated cases.

Figure 9 shows that respondents agree with the statement that the COVID-19 pandemic has increased product prices. COVID-19 caused disruptions in the global supply chain due to lockdowns, reduced workforce, and restrictions on transport and travel. These disruptions often lead to shortages of materials or products, causing a spike in prices. Businesses have faced increased operational costs due to the implementation of safety protocols, sanitization requirements, and increased costs for personal protective equipment for staff. These additional costs can be passed onto the consumer in the form of higher prices. In some cases, governments have been printing money to help stimulate

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the economy during the pandemic, which can lead to inflation and higher prices. Restrictions and safety measures have increased the cost of transporting goods, which can also contribute to the rise in product prices. As we can see from the research, the greatest price increase occurred for health care products and food, while the smallest was visible for luxury products. This data certainly leads us to the conclusion that some companies took advantage of the situation of increased demand for these products and immorally raised their product prices without a justified reason. Ethical behavior of companies is also what consumers remember and reward. The ethics of company management and corporate governance rests on the fact that the overall good of the company is the fiduciary duty of managers [142].

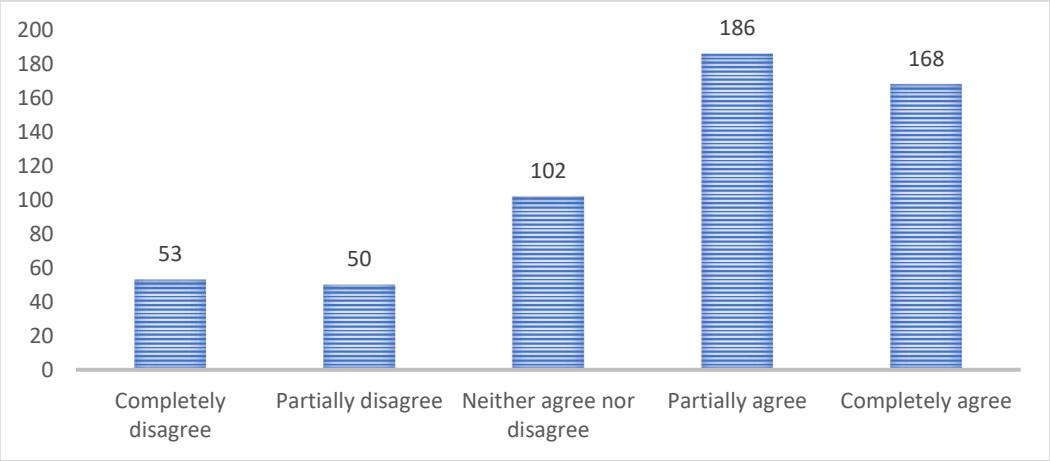

Figure 9. The COVID-19 pandemic has affected the rise in product prices?

As we can see in Figure 10, it is evident that there were supply chain issues during the COVID-19 pandemic, leading to product shortages in the market. Many factories around the world had to temporarily shut down or significantly reduce their capacity due to the pandemic, whether to comply with lockdown measures or because their workers got sick. With various countries implementing travel restrictions and quarantine measures, the transportation of goods became more difficult and slower. Air, sea, and land transport were all affected, which caused significant delays in shipping products from manufacturers to retailers, and finally to consumers. Certain goods such as personal protective equipment (PPE), home workout equipment, and home office supplies experienced a surge in demand. This sudden increase in demand put further pressure on the already strained supply chains and caused additional delivery delays. Increased scrutiny and controls at border crossings to prevent the spread of the virus also contributed to delays.

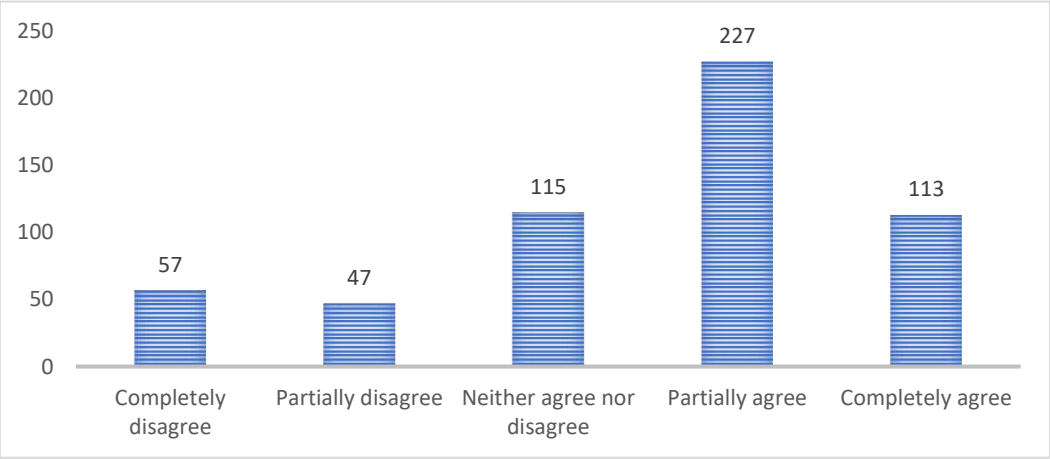

Figure 10. The COVID-19 pandemic has caused delays in product delivery?

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The results of a survey conducted on a sample of 559 respondents to determine the impact of the COVID-19 pandemic on the behavior of individual consumers indicate that this impact exists in several elements and is different. Thus, we confirmed the first hypothesis of the model (H1). Evaluating the presented alternatives, the results showed the dominance of online shopping among individual consumers. This confirms the second hypothesis of the model (H2). The evaluation of the criteria showed that incomes and savings remained relatively stable thanks to government support measures, while the global price flows affected the consumption imbalance, thus confirming the third hypothesis of the model (H3). Analysis of the hierarchical structure of the AHP model confirmed the absence of availability of products on the market because of restrictions on movement, work, and travel... thereby confirming the fourth hypothesis (H4).

The analysis results clearly show that the impact of the COVID-19 pandemic on individual consumption is varied, with a dominant negative impact on (i) product supply and (ii) delivery delays. In the hierarchical structure, the impact of COVID-19 on individual consumption in the Republic of Croatia is set as a goal or problem. We analyzed and assessed the criteria influencing consumer buying habits and the alternatives we have based on the chosen criteria. A complex hierarchical structure was established, demonstrating the strengths of Saaty's AHP model, such as interdependence, complexity, and unity. Furthermore, we evaluated the impact of each of these elements, which were subsequently interconnected and combined. Also, Saaty's strengths of the AHP model are evident here, like hierarchy, measurement, synthesis, and consistency.

Similar to the approach in the prior article [11], our analysis began by constructing a hierarchical structure using the AHP method. We organized the elements according to hierarchical levels and juxtaposed them at various levels and in respect to the overarching goal. The matrix was then filled with paired professional assessments.

In the AHP model, the priority vectors for each matrix are established through the additive normalization method. Using this technique (Figure 11), the Delay in Delivery (DD) is the most important goal criterion, the Lack of Products (LP) is in second place, Online Buying (OB) is third in rank, and Consumer Habits (CH) is fourth. Criterion Product Demand (PD), Panic Buying (PB), Income (I), and Savings (S) were noted with a lesser degree of COVID-19 impact. This matrix is accurately generated because the relations are generally correct. Using this method, we calculated a sufficiently high real eigenvector (λmax=8.833) and a consistency ratio of less than 10% (CR=0.084), which must be considered consistent.

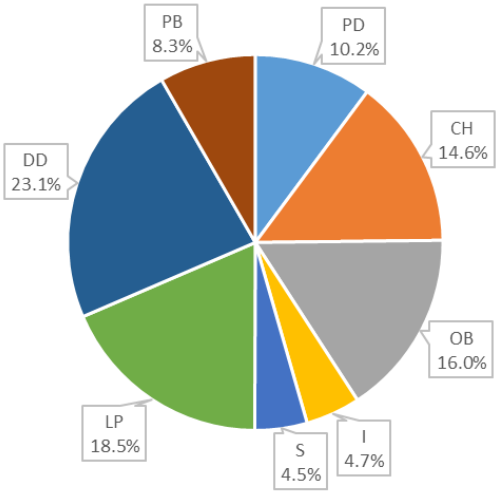

Figure 11. Priority vectors for criteria in standard AHP method, using the additive normalization method. Note: PD – Product Demand, CH – Consumer Habits, OB – Online Buying, I – Income, S – Saving, LP – Lack of Products, DD– Delivery Delay, PB – Panic Buying.

From the point of view of the two dominant criteria (DD and LP), according to Table 3, the best alternative is the product supply (PS). The second best is different. For DD it is product consumption

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(PC), and for LP the distribution chains. The worst alternative in the model is Smoothing Consumption (SC).

Table 3. Priority vectors for variants by criteria.

Alterntives/ Criteria	PD	CH	OB	I	S	LP	DD	PB
PC	0.387	0.269	0.237	0.248	0.177	0.168	0.264	0.275
DC	0.198	0.222	0.173	0.195	0.140	0.231	0.183	0.198
SC	0.140	0.128	0.138	0.137	0.264	0.117	0.139	0.140
PS	0.275	0.381	0.452	0.419	0.419	0.484	0.481	0.387

Note: PC – Product Consumption, DC – Distribution Chains, SC – Smoothing Consumption, and PS – Product Supply, PD – Product Demand, CH – Consumer Habits, OB – Online Buying, I – Income, S – Saving, LP – Lack of Products, DD – Delivery Delay, PB – Panic Buying.

We then calculated the consistency index (CR) since the eigenvalue (EV) method is an integral part of the standard AHP method. We measure the correctness of ranked priorities. The values important for a correct reading are found in Table 4, namely: maximum matrix eigenvalues (λmax), coincidence index (RI), consistency index (CI), and consistency rate (CR) [11].

Table 4. Degree of pairwise comparisons consistency by the method of eigenvalues.

	MATRIX							
	V1	V2	V3	V4	V5	V6	V7	V8
λmax	4.12	4.22	4.12	4.22	4.14	4.12	4.22	4.12
RI	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
CI	0.04	0.07	0.04	0.07	0.05	0.04	0.07	0.04
CR	0.05	0.08	0.04	0.08	0.05	0.05	0.08	0.05

From Table 4 we can notice that the consistency rate (CR) reaches values within tolerance, i.e., lower than 0.10, for all alternatives estimated according to the criteria. This means there is no need to re-evaluate the variants (see AHP algorithm ahead).

The final priority vectors of the alternatives, both in relation to the criteria and the overall goal, are determined by multiplying the priority vectors of specific criteria with the values of the priority vectors of the alternatives corresponding to the said criteria.

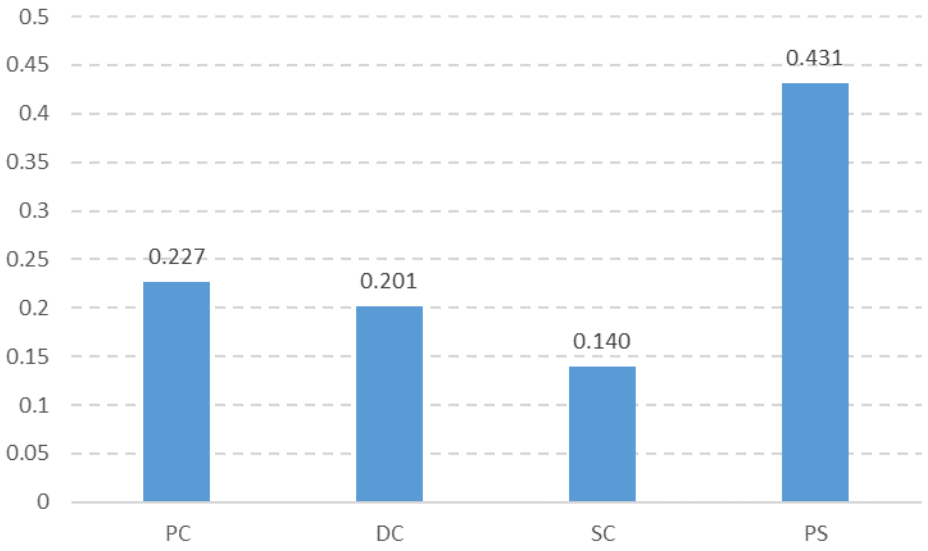

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Figure 12. Final priority vectors in standard AHP method, using the additive normalization method. Note: PC – Product Consumption, DC – Distribution Chains, SC – Smoothing Consumption, and PS – Product Supply.

Synthesizing the priority vectors of alternatives in relation to all criteria, we found that the impact of COVID-19 is greatest on Product Supply (PS), less on Product Consumption (PC) and Distribution Chains (DC), while the least impact is on Smoothing Consumption (SC).

The final verification of the hierarchical structure of the AHP method is sublimated into tables of weight vectors, both alternatives and criteria. In the final table (Table 5), the last field in the Priority column (sum of all alternatives) corresponds by value to the last field in the Weight Vectors row (sum of all criteria). That value is equal to 1. This means that the entire process was carried out methodologically correctly.

Table 5. Total weight and rank of variants.

	PD	CH	OB	I	S	LP	DD	PB	Priorities	range
PC	0.03	0.04	0.03	0.01	0.01	0.03	0.04	0.02	0.20	3
DC	0.02	0.03	0.05	0.01	0.01	0.05	0.06	0.01	0.23	2
SC	0.01	0.02	0.02	0.01	0.01	0.02	0.03	0.01	0.14	4
PS	0.04	0.06	0.06	0.02	0.02	0.08	0.10	0.04	**0.42**	**1**
Weight vector	(0.10)	(0.15)	(0.16)	(0.05)	(0.05)	(0.19)	**(0.23)**	(0.08)	1.00	
rang	5	4	3	7	8	2	**1**	6		

Note: PC – Product Consumption, DC – Distribution Chains, SC – Smoothing Consumption, and PS – Product Supply, PD – Product Demand, CH – Consumer Habits, OB – Online Buying, I – Income, S – Saving, LP – Lack of Products, DD – Delivery Delay, PB – Panic Buying.

The final Table 5 presents the results showing the values of the criteria and alternatives. The figures in the last two rows of Table 5 show the criterion scores (values in parentheses and rank). Delivery delay (0.23) was the most affected during the COVID-19 pandemic and significantly affected individual consumption. The dominant impact of the COVID-19 pandemic is the lack of products on the market (0.19). It is now clear that the impact of the pandemic on the global commodity market has been strong. This is indicated by the value of the alternative (The last two columns of Table 5 show the priorities and rank), where the greatest impact of the COVID-19 pandemic on the product supply (0.42). The survey results also show that a large percentage (about 60 percent) of respondents pointed out that the COVID-19 pandemic affected the absence of products from the market and delays in delivery. Therefore, we find out that the dominant impact of the COVID-19 pandemic is on the supply side. This further means that it was necessary to focus measures and interventions on the supply side (delivery channels, suppliers, sales, and margins) instead of the demand side (increasing in interest rates). The next important impact of the COVID-19 pandemic is on both buying and payments. There we can see that there has been an increase in online shopping (0.16), but at the same time, there is a significant impact on distribution trade chains (0.23). During the COVID-19 pandemic, online purchases and payments have grown significantly, primarily thanks to the progress of the ICT sector and government incentives to promote digitization. Also, a large percentage (over 50%) of respondents confirmed a greater share of online purchases.

The impact of the COVID-19 pandemic on the volume of purchases (0.10) and consumer habits (0.15) was not so strong. Respondents also confirmed that neither their shopping habits nor habits had changed significantly, nor had they stockpiled (panic buying, 0.08). At first, the media reported on stockpiling. The government successfully overcame this, using monetary incentives, on the demand side, and interventions from commodity reserves, on the supply side.

The decisive measures taken by the governments of many countries to protect jobs and wages have contributed to maintaining the living standards of their citizens. However, the successfully maintained income level came at the expense of new borrowing from less developed countries and

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debt monetization in developed countries. Thus, we have that the impact of the COVID-19 pandemic on Income (0.05) and Savings (0.05) is negligible. Hence, it is not surprising that the impact of the COVID-19 pandemic on Smoothing Consumption (0.14) is the least. Also, the monetary stimulus measures were aimed at protecting the banking sector, thereby additionally protecting citizens' deposits. Government measures have made it impossible to successfully forecast and smooth consumption by adjusting consumption patterns. Stimulus measures were necessary at the time, but they disrupted supply and demand in commodity markets, and at the same time made economic analysis difficult.

At the end of the analysis, we can praise that we used the advantages of the AHP model. The results of the AHP model proved to be satisfactory this time as well. The value of the consistency coefficient is below 0.10 (tolerance zone). This means that a new assessment of alternatives and criteria is not required.

This study has certain limitations that should be considered. Given that there are residents from rural areas who may not have accessible internet, or it concerns an older population, it's possible that these demographics participated less in the sample. As the study was conducted in the Republic of Croatia, respondents in other countries might have reacted differently to the posed questions. Since the intensity of the COVID-19 pandemic has changed over time, responses to the same questions might have varied at different points during the pandemic. There's a possibility that, even though the survey is anonymous, some respondents might not have wanted to answer truthfully, or they may not remember all the details associated with their purchases. As a variety of factors influenced the supply and demand in the market during the COVID-19 pandemic, it's very difficult to identify all existing variables.

4. Conclusions

The COVID-19 pandemic has altered the manner in which individuals live, perform their jobs, engage in shopping, and communicate. By studying these changes, companies can better understand them and more easily plan future marketing campaigns. The pandemic has accelerated digitization processes and approaches to consumer purchases in a digital environment. Some consumer habits remain even after the pandemic, and these habits will affect society and the economy.

This analysis, as well as our previous one [11], was aimed at assessing multi-criteria problems in the assessment of different impacts on the consumer. For this purpose, when deciding with multiple criteria (MCDM), we used the most applied model in the decision-making process, the AHP model.

The preliminary assessment of various factors influencing consumer decisions demonstrated that in Croatia, personal factors outweigh other elements like psychological, social, and cultural. This time, we outlined a new objective. At the apex of the hierarchical structure of the AHP model, we placed COVID-19 as a psychological factor in the consumer decision-making process. We gauged the impact of the COVID-19 pandemic on individual consumption using this AHP hierarchical structure.

This study provides more insight into the consumer perception literature during and after the COVID-19 pandemic. We have successfully identified new impact factors and examined the significance of the spread of the impact of COVID-19 on the consumer.

In our research, we showed that the greatest impact of the COVID-19 pandemic was measured on the goods market, where there were changes in the supply of goods (delay in delivery, lack of products on the market) and changed distribution channels (online purchases). It was proven that these influencers exhibited different levels. We found the spread of the impact of COVID-19 in the part of the impact on the types and groups of products they buy. Also, we observed a weak impact on the balancing of consumption, due to the interventions of the governments of all countries to preserve the wages and jobs of citizens. The mentioned trends indicate the stability of individuals' income. The rise in prices was caused due to more expensive raw materials for production, a more complicated supply chain, and unjustifiable price increases of necessary products during the COVID-19 pandemic. Companies have exploited the pandemic situation and tried to make a quick profit. As a result of this trend, the Republic of Croatia had to freeze the prices of basic food products.

Based on the results of this study, the impact of the pandemic on consumer behavior was significant only in some segments, but not definitive. The observed changes are a result of short-term reactions to crisis situations and circumstances that are not everyday occurrences rather than long-term changes in customer habits and behavior.

It is crucial for companies to monitor market trends, learn from existing crisis situations, and be prepared for the next market anomalies.

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