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Scoping Study: Changes in Dietary Behavior During the COVID-19 Pandemic

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Abstract

Eating behaviors are complicated and often influenced by several factors. Since the coronavirus disease 2019 (COVID-19) pandemic, several restrictive measures were taken to address the multifaceted impact of this disease. As a result, the lifestyle of people, and especially their eating habits were significantly disrupted. Eating and diet are major concerns and need careful management as they can have a huge impact on people's lives and day-to-day functioning. The aim of this systematic mapping study is to examine the effects of the COVID-19 pandemic on people's eating behaviors. More specifically, we compared people's eating behaviors before and after the outbreak of the pandemic. A total of 21 studies met our inclusion criteria and were included in the review. The main findings provided information on a dietary shift towards modified eating behaviors; characterized by increased consumption of snacks and a preference for sweet and processed foods instead of fruits, vegetables, and fresh foods. In some countries, an increase in alcohol consumption during the COVID-19 pandemic was also identified. These findings concern the need for more robust public health policies and strategies focusing on prevention and nutrition education.

1. INTRODUCTION

The emergence of the 2019 coronavirus disease (COVID-19), an infectious disease caused by a coronavirus [1,61], led to abrupt and radical changes globally from late 2019 to the present. Not only have relationship patterns shifted, but lifestyle habits have also undergone significant transformations due to lockdowns and the negative emotions experienced by the population (such as anxiety, fear, loneliness, etc.). Social distancing, reduced capacity in enclosed spaces, and mobility restrictions are just a few of the measures proposed and implemented by governments worldwide. Although the aim of these measures was to combat the spread of the pandemic, their impact on daily life has been substantial [2,3]. Since the first wave of the COVID-19 pandemic, many governments have made decisions affecting their populations, such as staying at home or following specific measures when outdoors. Consequently, people from various countries suddenly had to eat all their meals at home and adapt their physical activity to indoor spaces as they were not allowed to go to regular exercise venues or even public places (such as parks or fields) [4,5]. In other cases, lifestyle habits underwent abrupt changes due to the lack of social services, such as school meals [6], and overall food insecurity [7]. As a result, dietary behaviors could vary among age groups, as indeed happened [8-10,61].

Dietary behaviors can be defined as food choices related to consumption trends, personal preferences, specific diets, and calorie measurement [11,12,32]. Several contemporaneous studies have been conducted since the onset of the pandemic, aiming to define and research this field [8–10,13–17]. However, most studies fail to identify differences in dietary behavior compared to before the pandemic, potentially leading to bias when interpreting results [18-22]. This limitation seems to have been addressed by summarizing information in some systematic reviews that have investigated the pandemic's impact on dietary and social aspects [18-22,61].

In this context, a wide range of dietary behaviors, including weight gain or loss, has been observed. Special attention is given to the analysis of the consumption of unhealthy foods [19,20]. These findings remain unclear for healthy individuals but also for vulnerable groups, such as the elderly population and obese individuals, who experience more significant and intense changes in their dietary behavior [21,22].

Specifically, the global impact of the COVID-19 pandemic on the daily diet of adults has been observed [19-31]. Although establishing a correlation between weight gain and changes in dietary behavior, and whether it is accompanied by increased appetite, was challenging, greater consumption of unhealthy snacks and a higher number of daily meals were noted. In the case of children, similar conclusions seem to arise, as there is a correlation with school closures and, consequently, the impact on school cafeterias that have affected many families [6]. This situation has worsened the quality of diet in families with limited financial resources and those where all members are engaged in manual labor [48]. Finally, for dependent individuals or vulnerable social groups, such as the elderly, people with morbid obesity, and people with other disabilities, scientific evidence has linked preventive measures involving social contact restrictions to even more pronounced changes in dietary behavior. In conclusion, the changes brought to the global population's life by COVID-19 are associated with a significant decline in dietary health [20].

This phenomenon was particularly pronounced in developing countries, where the outbreak of the COVID-19 pandemic reinforced the need for a proper definition of the concept of "dietary security." Despite the "availability" and "accessibility" of food supplies, problems arose in supply chains. As a result, families were not properly supplied with their usual foods and were forced to change their dietary behaviors, contributing to a decrease in dietary health [7]. It is crucial to establish this differentiation when referring to "changes in dietary behavior during the COVID-19 pandemic," as decisions regarding food were motivated by different reasons in each case. The outbreak of COVID-19 triggered various types of dietary changes in each country and social group.

In light of the above, the results indicate the need for a proper understanding of the changes in dietary behavior that occurred during the evolution of the COVID-19 pandemic, ideally focusing on studies that can yield valid results by comparing corresponding habits before and after the pandemic. Therefore, the main objective of this study is to analyze research from September 2019

to evaluate changes in dietary behavior, taking into account the following research question:

● What changes have occurred in dietary behavior during the COVID-19 pandemic?

Accurate descriptions of these changes are expected to better understand the consequences. These findings can be used in relation to future policies and strategies for assessing and managing diets in situations of particular circumstances, such as the current COVID-19 pandemic.

2. METHODOLOGY

The research was conducted following the standards of a Systematic Mapping Study. A systematic mapping study, or scoping study, is a process of collecting and categorizing data with the aim of forming a general overview of the area or field that requires investigation [62]. The first step involves an in-depth literature review, followed by an analysis that allows the classification of results according to predefined criteria set by the researchers [63]. The choice of a systematic mapping study aids in completing a mapping of a field and, in the long term, enhances research work on a global scale. This specific research type is primarily used for educational purposes and for generating problematics and research hypotheses [64,65].

The research strategy on platforms, specifically PubMed, Research Gate, Scopus, and Google Scholar, took the following form: ("COVID-19" OR "coronavirus" OR "quarantine" OR "coronavirus pandemic") AND ("feeding behavior" OR "diet, healthy" OR "diet" OR "Diet, Food, and Nutrition" OR "healthy eating" OR "dietary pattern" OR "food intake" OR "nutrition")

Out of a total of 68 studies, 21 were included in this study following the criteria below:

Inclusion Criteria:

- Available in the English language.
- Published in 2019 or later.
- Used as a reference in other studies.

Exclusion Criteria:

- Accessible only in abstract form.
- Written in a language other than English.
- Duplicate copies of other studies.

3. RESULTS

The research studies included in the analysis possess the following features:

First Author/Year/ Region (Country)	**Total n/Female (%)**	**Research Method**
Khare, (2020) Bhopal (India)	n = 143 Female = 36.36% (n = 52)	Questionnaire designed for this validated study
Munasinghe, (2020) New South Wales (Australia)	n = 1298 Female = 80.5% (n = 1045)	Self-reported dietary behaviour was measured using questions validated for adolescents by the NSW Centre for Public Health Nutrition
Medrano, (2020) All regions (Spain)	n = 291 Female = 47.8% (n = 139)	The Mediterranean Diet Quality Index for children and teenagers (KIDMED)

Pietrobelli, (2020) Verona (Italy)	n = 41 Female = 46.34% (n = 19)	12 items validated lifestyle questionnaire (sports activity participation, screen time, sleep behaviour, and eating habits, focusing on servings of red meat, pasta, snacks, fruits, and vegetables)
Pellegrini, (2020) Nothern Italy (Italy)	n = 150 Female = 77.33% (n = 116)	A validated 12-question multiple-choice questionnaire
Martínez-Steele, (2020) All regions (Brazil)	n = 10,116 Female = 78% (n = 7895)	A validated simplified questionnaire about diet
Deschasaux-Tanguy, (2020) All regions (France)	n = 37,252 Female = 52.3% (n = 19.483)	Web-based 24-h dietary records
Zhang (2020), All regions (China)	n = 1994 Female = 62.79% (n = 1252)	(2021) A standardized survey, (2) the Household Dietary Diversity Score (HDDS), and (3) a series of questions regarding changes in dietary behaviours
Yu (2020), All regions (China)	n = 10,082 Female = 72.39% (n = 7298)	COVID-19 Impact on Lifestyle Change Survey (COINLICS)
Barone, (2021) Pennsylvania (USA)	n = 112 Female = 69% (n = 77)	Diet Screener Questionnaire
Curtis, (2021) Adelaide (Australia)	n = 61 Female = 65.6% (n = 40)	Dietary Questionnaire for Epidemiological Studies (DQUES and diet v3.2; Cancer Council Victoria)
Jia, (2021) All regions (China)	n = 10,082 female = 71.7% (n = 7320)	(2021) Food frequency questionnaire, and (2) Beverages Diet frequency questionnaire
Lamarche, (2021) Quebec (Canada)	n = 853 female = 87.2% (n = 744)	Self-administered web-based 24-h time dietary recall
Czenczek-Lewandowska, (2021) South-east Poland (Poland)	n = 506 Female = 70.2% (n = 355)	The modified Food Frequency Questionnaire (FFQ-6)
Naughton, (2021) High deprivation areas of all regions (United Kingdom)	n = 1044 Female = 72.7% (n = 747)	(2021) An online survey (3 months of daily ecological momentary assessments (EMA)), and (2)

		Daily health behaviour monitoring
Imaz-Aramburu, (2021) Basque Country (Spain)	n = 267 Female = 76% (n = 203)	(2021) An ad hoc self-administered questionnaire, (2) the Mediterranean diet (MedDiet) questionnaire
Maffoni, (2021) All regions (Italy)	n = 1304 Female = 74.62% (n = 973)	(2021) A 38 multiple-choice web-form survey in Google Forms, and (2) 10 multiple-choice items
Hosomi, (2021) Kyoto (Japan)	n = 34 Female = 67.65% (n = 23)	A validated self-administered questionnaire related to stress and lifestyle factors
Herle, (2021) All regions (United Kingdom)	n = 22,374 Female = 76% (n = 16,984)	Self-reported eating Changes
Dun, (2021) Zhejiang and Hunan (China)	n = 12,889 Female = 80.22% (n = 10,340)	An 81-item-online follow-up questionnaire
Sato, (2021) All regions (Japan)	n = 5929 Female = 69% (n = 4087)	CALO mama health app

Aim and results:

First Author/Year/ Region (Country)	**Results**
Khare, (2020) Bhopal (India)	Dietary changes were observed regarding the type of diet, meal timing, meal frequency, and changes in the quantity of diet.
Munasinghe, (2020) New South Wales (Australia)	There were reductions in fast food consumption, with no significant changes in the consumption of fruits and vegetables.
Medrano, (2020) All regions (Spain)	Children worsened their lifestyle behaviors during COVID-19 with restrictions on adherence to the Mediterranean Diet. No statistically significant differences were found in behaviors between primary and secondary school students.
Pietrobelli, (2020) Verona (Italy)	The number of meals consumed per day increased. There were no changes in vegetable intake, while fruit intake increased. Increased consumption of potatoes, red meat, and sugary drinks was observed during the lockdown.
Pellegrini, (2020) Nothern Italy (Italy)	Increased consumption of snacks, cereals, and sweets was observed.

Martínez- Steele, (2020) All regions (Brazil)	Consumption of vegetables, fruits, and legumes increased daily in the diet. There was a stable pattern in the consumption of processed foods, although the number of people consuming it increased.
Deschasaux- Tanguy, (2020) All regions (France)	Dietary behaviors during the COVID-19 lockdown changed. Difficulty in maintaining a regular meal schedule and reduced consumption of fresh foods were reported. The consumption of processed foods increased.
Zhang, (2020) All regions (China)	Increased consumption of seafood and dietary supplements was noted. Additionally, the consumption of frozen and raw foods decreased, while there was a higher intake of alcohol.
Yu, (2020) All regions (China)	Significant changes in food intake frequency occurred after the lockdown. There was a decrease in rice intake, while the consumption of other staple foods such as fish, eggs, fresh vegetables, canned vegetables, fresh fruits, and dairy increased. Increased consumption of wheat products and a decrease in beverage intake frequency were observed.
Barone, (2021) Pennsylvania (USA)	No changes were found in dietary habits, except for reduced red meat consumption.
Curtis, (2021) Adelaide (Australia)	Overall dietary behavior did not change, but a slightly lower protein intake and an increase in alcohol consumption were recorded.
Jia, (2021) All regions (China)	Significant changes in dietary patterns were associated with more frequent consumption of wheat products and less frequent consumption of rice, meat, poultry, fresh vegetables, fruits, soy, dairy, and sugary drinks.
Lamarche, (2021) Quebec (Canada)	Small but significant increases were observed in the following components: whole grain cereals, greens and beans, processed cereals (reduced consumption), vegetables, dairy, seafood, and plant proteins. Additional sugar consumption decreased slightly. The quality of the diet improved slightly.
Czenczek- Lewandowska, (2021) South-east Poland (Poland)	There was an increase in the average consumption of sweets, snacks, and cereals. A significant increase in alcohol and fat intake was recorded.
Naughton, (2021) High deprivation areas of all Regions (United Kingdom)	There were reductions in the average daily servings of vegetables and fruits, but no change in reported servings of high-sugar food. In the case of alcohol consumption, there was an increase in the average monthly intake.
Imaz- Aramburu, (2021) Basque Country (Spain)	There was greater adherence to the Mediterranean Diet. Vegetable consumption increased significantly during the pandemic, while the consumption of fatty meat tended to increase. Increased consumption of nuts was recorded.
Maffoni, (2021) All regions (Italy)	Negative changes were found in dietary behavior. These included increased consumption of desserts or sweets at

	lunchtime, consumption of food between meals, and higher consumption of unhealthy snacks, drinks, and processed foods.
Hosomi, (2021) Kyoto (Japan)	The average amount of food intake increased. Snack and ready-to-eat food consumption also increased significantly.
Herle, (2021) All regions (United Kingdom)	Many people experienced changes in food intake, moving away from healthy eating patterns.
Dun, (2021) Zhejiang and Hunan (China)	The study lasted for 4 months. The first stage of the research emerged before the COVID-19 pandemic lockdown, and the second stage was conducted 4 months later, among the same participants. Greater alcohol consumption, especially in men, was observed. The daily frequency of snacks also increased.
Sato, (2021) All regions (Japan)	Workers tended to consume fewer fruits and dairy products but more meat and alcohol compared to non-workers. Specifically, workers who had stopped working consumed fewer vegetables, mushrooms, and fish.

All studies documented changes in dietary behavior during the COVID-19 pandemic. Two studies found changes in meal timings [26,37], while three reported increased frequency of food intake [26,35,39], and four noted an increased quantity of food consumed [26,31,46,47]. Specifically, five studies highlighted higher consumption of snacks [33,35,41,44,47]. In this context, three studies demonstrated a preference for sweets [33,35,44], while two concluded that wheat products were consumed more frequently during the COVID-19 pandemic [39,40]. Regarding beverages, two studies found higher daily intake [35,40], while one reported decreased intake [39]. Specifically, for alcoholic beverages, six studies reported increased consumption [28,38,41,44,45,48].

Additionally, four studies reported reduced consumption of fruits and vegetables [39,40,45,48], two found no substantial changes [27,31], and two reported an increased daily intake [30,36]. In the same context, three studies observed reduced consumption of fresh foods [37,39,40], and four other studies reported higher intake of highly processed foods [35-37,47]. Meat consumption decreased according to two studies [40,42], but also increased according to three studies [30,31,48].

Finally, three studies indicated negative changes in dietary behavior due to lower adherence to healthy diets [29,35,46], while two reported adherences to a healthy diet [30,43], and one study stated that there were no changes in dietary habits except for a reduction in the quantity of consumed meat [42].

4. FURTHER DISCUSSION

The current systematic mapping study, which included twenty-one studies, provides a comprehensive overview of the characteristics of dietary behavior related to the COVID-19 pandemic. In agreement with previous reviews, several results, such as overeating [26,31,46,47] and the influence of personal preferences on food choices [33,35,44], have been observed. However, this systematic review also found that meal frequency is not related to the quantity of food consumed [36,40]. Additionally, variables such as gender and age showed no correlation with specific dietary behaviors [29], while the impact of mental health is a factor for further examination [41,45,46,34]. Regarding employment status, one study found that people spending more time at home consumed a greater quantity of self-cooked food [48], which seems to be related to the

availability of food delivery services [51], a faster option for those in a hurry.

However, when referring to a population without pathological conditions, ambiguous results may arise. Three studies reported stability patterns in dietary behavior despite the pandemic outbreak [27,28,42], while two studies even reported improvements in adherence to healthy diets [38,43]. Nevertheless, the results showed more frequent food intake, increased consumption of processed foods, and higher caloric intake due to frequent alcohol consumption [35,37,44,46,48].

Concerning specific subgroups, individuals with diabetes seemed to increase their daily food intake. Unhealthy foods such as sweets and starchy foods were common in this population [26,32,47]. Similarly, individuals with obesity exhibited similar trends, reporting a significant increase in the quantity and frequency of unhealthy foods [33]. In the case of young people, lower adherence to healthy diets, such as the Mediterranean Diet, was found due to increased food intake, a preference for snacks, and a lack of fruit and vegetable intake [27,29–31,34,39–41]. Additionally, economically vulnerable populations showed reduced food intake, combined with increased alcohol consumption [45].

Taking all this information into account, changes in dietary behavior during the COVID-19 pandemic can be confirmed. However, some limitations should be considered in interpreting these results. Firstly, due to the heterogeneity of the studies, this review should be considered an approach to changes in dietary behavior during the COVID-19 pandemic, which cannot be considered definitive. The results may be useful for future reviews when more studies become available. Secondly, this review included both clinical and non-clinical populations, which may disturb the results due to additional unmeasured variables. Additionally, while some studies were conducted on extremely large samples [46], others included a very small number of statistical units, creating serious limitations in generalizing the conclusions of these studies.

Therefore, any interpretation should be made carefully, as it may not represent dietary behavior in the entire society, although previous studies have demonstrated common dietary behavior changes between clinical and non-clinical populations [21,22]. Finally, although one of the strengths of this mapping study is the inclusion of various countries, it is important to note that restrictive measures were different among countries, and the COVID-19 pandemic may have had a greater or lesser impact depending on each country's policies [36].

Thus, this review serves as a reference point contributing to the current body of knowledge regarding the impact of the COVID-19 pandemic on daily life. Confirming the occurrence of changes in dietary behavior since the onset of the COVID-19 pandemic, this is one of the first Greek-language studies that has successfully described these changes in different countries. The results of this study will provide a reference for guiding future research directions for those interested not only in this topic but also in specific dietary patterns and the differences between "quantity of food" and "snack frequency," for example. All these approaches will lead to a better understanding of dietary behavior during the COVID-19 pandemic and contribute to future guidelines on health promotion.

5. CONCLUSIONS

The outbreak of COVID-19 led to changes in dietary behaviour during the pandemic, which may have become less healthy. Although these changes could be a result of uncertainty and discomfort, adverse health effects, especially for vulnerable populations, emphasize the need to promote healthy habits through preventive interventions and government-supported social actions. However, for a more accurate analysis and clear results, further research should be conducted. In this context, it would be essential to focus on food intake as well as alcohol consumption and its consequences, as the impacts on the latter were evident.

With this, not only can a "dietary behaviour in a health and social emergency" be developed, but a reference point for future directions can also be established to improve guidelines for achieving proper nutrition in the new normal.

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