

# Impact of the COVID-19 pandemic on food and drink consumption and related factors: A scoping review

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## Abstract

**Background:** The lockdown imposed due to the coronavirus disease (COVID-19) pandemic has caused several lifestyle changes. **Aim:** This scoping review aimed to report the present status of studies conducted on changes and factors related to food and drink consumption worldwide. **Methods:** Searches were performed in PubMed and EBSCO between August 6 and August 22, 2020 using the following criteria: (1) studies reporting changes in the current individual consumption of specific foods and snacks compared to that before the COVID-19 pandemic; (2) participants aged 18 years or older and without any diagnosable disease; and (3) articles that are peer-reviewed publications available in English. Studies were excluded if they involved an intervention related to diet or investigated the change in COVID-19 incidence. **Results:** Twelve articles were included in this review. The included studies revealed that there were various changes in food and drink consumption, such as the frequency and amount of consumption of snacks ( $n=9$ ), alcohol ( $n=7$ ), and vegetables and fruits ( $n=5$ ). These changes showed both increasing and decreasing trends. Of the 12 studies, 10 reported factors related to dietary changes, such as age, body mass index, psychological conditions, and residence; however, most of the results regarding these factors were inconsistent. **Conclusions:** Future studies should investigate long-term dietary changes and examine the factors that influence these changes to determine the pandemic's long-term impact.

## Keywords

COVID-19, food consumption, lockdown, scoping review, factors

## Introduction

The novel coronavirus disease (COVID-19) was first identified in Wuhan, the capital of the Hubei Province in China, rapidly spread worldwide, and was declared a pandemic on March 11, 2020 (World Health Organization, 2020a). Several countries and territories implemented community-wide lockdowns, home quarantines, remote work, and social distancing to stop the spread of COVID-19.

These stringent preventive measures have led to significant lifestyle changes. Particularly, staying at and working from home can affect diet, food choices, and food access. A World Economic Forum (2020) report focusing on 13 countries predicted that snack consumption would decrease in the USA, Brazil, South Africa, Russia, UK, France, Germany, Spain, Italy, India, Japan, Korea, and China (the McKinsey & Company Consumer Pulse surveys were conducted globally between March 15 and April 6, 2020) (World Economic Forum, 2020). The WHO-Europe opined that self-quarantine and temporary business closure to control COVID-19 may influence normal food-related practices and

limit access to fresh food, potentially compromising opportunities for a healthy, varied diet, and lead to increased consumption of ultra-processed foods—high in fats, sugars, and salt (World Health Organization, 2020b). The COVID-19 pandemic could result in lifestyle changes, characterized by reduced physical activity (PA) and increased consumption of unhealthy foods (Mattioli et al., 2020), which could affect behavioural risk factors for weight gain (Parekh and Deierlein, 2020).

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While these unhealthy dietary changes have been reported, healthy dietary changes could also have occurred. People's awareness for maintaining a healthy body is expected to have improved to prevent severe COVID-19, with more home-cooking due to more time being spent at home. In a previous study, higher vegetable consumption was associated with more free time and home-cooked meals (Appleton et al., 2016). Bennett et al. (2021) conducted a review to assess dietary changes during the first lockdown and suggested that the effect of the COVID-19 lockdown was both favourable (increase in fresh produce and home cooking and reduction in comfort foods and alcohol consumption) and unfavourable (reduction in fresh produce and increase in comfort foods and alcohol consumption). However, their review included articles that were yet to undergo peer-review, targeted participants of all ages, did not exclude patients with COVID-19 or those with other diseases, and did not report the factors related to dietary changes.

Understanding the dietary changes that occurred after the declaration of the COVID-19 pandemic is important for designing future health-promotion strategies because these changes are expected to continue. Health care workers are required to guide those who have adopted unhealthy dietary habits. To practice effective health promotion, researchers should clarify the factors that influence dietary changes.

This scoping review aimed to report the present status of studies on changes in food and drink consumption caused by the COVID-19 pandemic among a general adult population worldwide. To achieve this aim, we examined the extent of research conducted on how the pandemic has changed food and drink consumption compared to the pre-pandemic situation. This study summarizes the health status and quality of life (QOL) as outcomes of dietary changes and factors related to dietary changes reported by studies assessing the impact of the COVID-19 pandemic on dietary habits.

## Methods

The study followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses—Extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al., 2018), which comprises 20 essential and two optional items of the 27 PRISMA checklist items after excluding items that are inapplicable for a scoping review.

### Search strategy and inclusion criteria

We searched the PubMed and EBSCO databases from August 6 to 22, 2020. The search terms were ("COVID-19") AND ("diet" or "food" or "nutrition" or "eating behaviour" or "dietary habit") AND ("change" or "difference" or "impact" or "influence" or "effect") for peer-reviewed articles in English reporting changes in the individual consumption of specific foods and snacks

compared to the pre-pandemic situation in adult participants (age >18 years). Studies focusing on participants with diseases, such as obesity, diabetes, and human immunodeficiency virus infection; involving any dietary interventions; or investigating changes in COVID-19 incidence and treatment were excluded. A manual search of the studies' reference lists was performed subsequently to identify relevant articles.

### Article screening

Duplicated articles were removed. Subsequently, two members of the study team independently selected the manuscripts using a two-stage strategy, namely (1) title and abstract screening and (2) full text review. Any discrepancies were resolved through discussion or third-party mediation, if required.

### Data extraction

Data were extracted and verified by three authors. The extracted data included study characteristics (author, year of publication, sample size, country, study design, data collection method, survey date, and purpose), population characteristics (age, sex), dietary changes, health status and QOL, and dietary-change-related factors, such as demographic characteristics, health status, and lifestyle. We categorized the dietary changes into three groups: "increase," "decrease," and "others;" "others" included items other than changes of frequency and quantity. Following data extraction, narrative synthesis was performed to summarize the main results of the studies considering the review objectives. When summarizing the main results of the included studies, we categorized "changes in dietary habits," "health status and QOL," and "factors related to change in dietary habits," referencing the Precede-Proceed model (Green and Kreuter, 2005).

### Assessment of methodological quality

All included studies were assessed for methodological quality using the 14 items of the quality-assessment tool for observational cohort and cross-sectional studies developed by the National Heart, Lung, and Blood Institute (2020) and independently graded by two authors. Disagreements were resolved by consulting a third author and carrying out a discussion until a consensus was reached. Each article was graded, after which, the overall quality was rated as "Good," "Fair," or "Poor" if the articles were positively evaluated as "Good" 6 or more times, 3–5 times, and 0–2 times, respectively.

## Results

We identified 854 potentially relevant articles after removing duplicates; 21 full-text articles were assessed for inclusion after screening, and 11 met the inclusion criteria. An additional paper was identified based on the reference

**Table 1.** Summary of the main characteristics of the included studies.

Study (Country)	Sample (N, sex, age)	Survey date	Data collection method	Change in food and drink consumption			Health status and QOL	Factors related to change in dietary habits
				Increase	Decrease	Others		
Luo et al. (2020) (China)	N = 2772 M/F: 507/2265 Average Age: 24.1 (SD: 9.1) years	From February 26 to February 29	Online survey using a mobile app Recruited using an online snowball sampling method	Consumption of snacks (18.7%), vegetables (31.3%), fruits (27.5%), dark vegetables (19.6%), water/tea/coffee (29.3%), whole grains (21.1%), eggs (19.9%), milk and its products (16.1%), nuts (15.7%), refined grains (15.4%)	Consumption of snacks (23.6%), sea cucumbers (34.0%), fish/shrimps/crabs (29.9%), poultry meat (28.8%), livestock meat (28.6%), sugary drinks (26.6%), refined grains (18.0%), ginseng, cubilose, and tremella (15.5%), nuts (13.3%), mushrooms (12.7%)	NR	Older participants, those paying more attention to nutrition and those with immunity-related knowledge, living in cities other than the first-tier cities, and having high scores on food safety practices were more likely to change their dietary habits.	
Yan et al. (2020) (China)	N = 9016 M/F: 3839/5177 Age Range: 18–29 years (48.9%)	From April 25 to May 11, 2020	Online survey via WeChat (social media in China)	Alcohol consumption (increased a lot [15.6%]; increased a little [15.2%]; total increase: 30.8%)	Alcohol consumption (decreased a lot [18.7%]; decreased a little [17.2%]; total decrease: 35.9%)	High impact on diet (12.8%)	Perceived high SARS-CoV-2 infection risk was associated with an increase in drinking.	
Wang et al. (2020) (China)	N = 2289 M/F: 1176/1113 Average Age: 27.5 (SD: 12.0) years	From March 23 to April 26, 2020	Online survey via commercial online survey platforms (i.e. WenjuanXing and WeChat)	Amount of consumption of snacks (about 30%); vegetables, fruits, and dairy products (>30%); frequency of daily consumption (17.3%)	Frequency of daily consumption (23.1%)	Eating habits became healthier (23%)	NR	

(continued)

Table 1. (continued)

Study (Country)	Sample (N, sex, age)	Survey date	Data collection method	Change in food and drink consumption			Health status and QOL	Factors related to change in dietary habits
				Increase	Decrease	Others		
Rodríguez-Pérez et al. (2020) (Spain)	N = 7514   M/F: 2204/5305 Age Range: 21–35 years; 2558 people (34.0%)	Open from March 20, 2020	Online survey via instant messaging apps, social media, social networking sites, and emails	Frequency of consumption: snack (37.6%), alcohol (10.4%), fried food (6.3%), of fast food (5.1%), and home-cooking (45.7%)	Frequency of snack consumption (15.7%), alcohol consumption (57.3%), fried food consumption (20.3%), frequency of fast food (34.9%), cooking frequency (3.6%)	Eating more (36.3%), MEDAS score from 6.53 ± 2 to 7.34 ± 1.93	Weight change (gain: 12.8%)	The participants who lived in the north of Spain, with children in care and those with unknown weight gain were less likely to adhere to the MedDiet. The participants who were postgraduate and lived alone were more likely to increase adherence to the MedDiet. The odds of adherence to the MedDiet increased by 8% per 5 days of confinement.
	N = 600 M/F: 300/300 Average Age: 42.6 (SD: 12.3) years	The last week of April 2020	Online national survey	Consumption of sweets (>50%); consumption of other food categories (>50%)	Consumption of fish (>33%), consumption of other food categories (>33%)	NR	NR	Those who had greater restraint were likely to decrease consumption of snacks and ultra-processed foods and to increase the consumption of nutritional supplements.
Papandreou et al. (2020) (Spain and Greece)	Spain N = 1002 M/F: 298/704 Average Age: 46.1 (SD: 13.3) years Greece N = 839 M/F: 279/560	Spain: from April 23 to May 18, 2020; Greece: from May 3 to 20, 2020	Online survey (different online platforms and mainstream social media)	Snack consumption between meals (Spain: 34.1%, Greece: 40.8%); food consumption (Spain: 11.4%, Greece: 18.1%)	Food consumption (Spain: 74.3%, Greece: 63.1%)	Meal plan has changed: I plan better (Spain: 11.6%, Greece: 21.1%) and I plan worse: (Spain: 36.1%, Greece: 33.7%)	Weight change, gain: 38.4% (Spain), 39.8% (Greece) Worse health: 0.9% (Spain), 4.6% (Greece)	There were differences between Spain and Greece in the changes in food consumption and meal plans. An increased number of snacks between meals was positively related to the PHQ and GAD scores. Changes in the meal plans were negatively correlated with the PHQ scores.

(continued)

**Table 1.** (continued)

Study (Country)	Sample (N, sex, age)	Survey date	Data collection method	Change in food and drink consumption			Health status and QOL	Factor's related to change in dietary habits
				Increase	Decrease	Others		
Górnicka et al. (2020) (Poland)	Average Age: 42.4 (SD: 11.7) years N = 2381 M/F: 243/2138 Age Range: 30–39 years; 1067 people (44.8%)	From April 30 to May 23, 2020	Online survey via social media, such as Facebook, Instagram, and WhatsApp, and through personal contacts by the research group members	Confections (32.5%), salty snacks (18.1%), alcohol (18.1%), vegetables (18.5%), and fruits (15.2%); total food consumption during the pandemic (34.3%); other foods <sup>3</sup>	Confections (18.8%), salty snacks (19.7%), alcohol (10.7%), vegetables (19.4%), and fruits (20.1%); total food consumption during the pandemic (14.1%); other foods <sup>3</sup>	Dietary change pattern (pro-healthy: 27.6%, constant: 53.0%, unhealthy: 19.4%)	NR	Pro-health change in pattern was negatively associated with age and living in a macroeconomic region with GDP > 100% of EU-28, and positively associated with BMI before the pandemic, increased physical activity, and increased or decreased sleep time. Unhealthy change in pattern was positively associated with living with a partner and/or children, not working or having a considerable work time reduction, living in a macroeconomic region with GDP > 100% or 50–100% of EU-28, decreased physical activity, and increased screen time.
Sidor and Rzymiski (2020) (Poland)	N = 1097 M/F: 541/1043 Average Age: 27.7 (SD: 9.0) years	From April 17 to May 1, 2020	Online survey via online social media	Frequency of snack (51.8%) and alcohol consumption (14.6%)	NR	Eating more (43.5%)	Weight change, gain: 29.9% [mean ± SD: 3.0 ± 1.6 kg], loss: 18.6% [ – 2.9 ± 1.5 kg])	Increased consumption of food and snacks were reported by individuals with higher BMI.
Stanton et al. (2020) (Australia)	N = 1491 M/F: 484/999 Average Age: 50.5 (SD: 14.9) years	From April 9 to April 19, 2020	Online survey via social media sources and institutional sources, including emails and public marketing	Alcohol consumption (18.1%)	Alcohol consumption (26.6%)	NR	Psychological distress (extremely severe: depression, 7.4%; anxiety, 5.2%; and stress, 3.0%)	Those who reported an increase in alcohol consumption were more likely to have higher depression, anxiety, and stress symptoms.
Zachary et al. (2020) (USA)	N = 173 M/F: 77/96 Average Age: 28.1 (SD: 12.5) years	NR	Online survey via Facebook	Post-dinner snacking (small, moderate, and large amount), increased: (65.32%); eating with friends and family; eating in response to sight and smell	NR	NR	Weight change (gained 5–10 pounds: 22%; stable: 59%; lost 5–10 pounds: 19%)	Weight gain associated with post-dinner snacking; eating in response to stress; and eating because of the appearance and smell of food.

(continued)

Table 1. (continued)

Study (Country)	Sample (N, sex, age)	Survey date	Data collection method	Change in food and drink consumption			Health status and QOL	Factors related to change in dietary habits
				Increase	Decrease	Others		
Reyes-Olavarria et al. (2020) (Chile)	N = 700 M/F: 172/528 Age: 31 years (median)	From May to June 2020	Online survey via institutional emails, Facebook, Instagram, WhatsApp, and Twitter	Consumption of vegetables and fruits (30.9%); consumption of foods (51.3%); frequency of cooking at home (59.6%)	Consumption of vegetables and fruits (20.7%); consumption of foods (14.9%); frequency of cook at home (5.7%)	Eating style perception: healthier than before (33.7%); less healthy than before (26.7%)	Weight change (male, female), gain: 25.6%, 38.1%; stable: 54.6%, 47.7%; loss: 19.8%, 14.2%	Decreased physical activity was positively associated with decreased vegetable consumption, perception of having a healthier diet, and eating more food than before. Increased weight perception was positively associated with eating more or less food, cooking more or less than before, and the perception of having a healthier diet.
Ammar et al. (2020) (International <sup>2</sup> )	N = 1047 M/F: 484/563 Age Range: 18–35 years; 577 people (55.1%)	From April 6 to 11, 2020	Google online survey platform via emails, shared in official pages of consortium's faculties, ResearchGate, LinkedIn, Facebook, WhatsApp, and Twitter	Frequency of snack consumption between meals or a late-night snack (during lockdown vs. before lockdown: 15.4% vs. 6.4% for always), unhealthy food (10.9% vs. 6.2% for always), number of main meals (14.5% vs. 6.6% for 4 main meals, 6.3% vs. 2.4% for 5 main meals, and 2.8% vs. 0.8% for >5 main meals)	Frequency of alcohol binge drinking (during lockdown vs. before lockdown: 5.4% vs. 10.1% for sometimes)	NR	NR	NR

QOL, quality of life; M/F, male/female; NR, not recorded; PA, physical activity; MedDiet, Mediterranean diet; PHQ, Patient Health Questionnaire; GAD, general anxiety disorder.

<sup>1</sup>Legumes, meat, fruits, egg, pasta/rice, bread, cereals, fish, sausages/cold nuts, vegetables, milk/dairy products, and alcoholic beverages.

<sup>2</sup>Asian (36%, mostly from Western Asia), African (40%, mostly from North Africa), European (21%), and other (3%) countries.

<sup>3</sup>Proportions of participants with increased and decreased consumption of the following foods (% increase and % decrease, respectively): whole grains, 16.3% and 11.4%; low-fat meat and/or eggs, 15.7% and 9.7%; pulses, 13.9% and 8.5%; fish and seafood, 6.8% and 17.0%; milk and milk products, 20.8% and 8.2%; processed meat, 10.9% and 17.7%; fast foods, 8.1% and 36.6%; sweetened spreads, 3.7% and 4.7%; commercial pastries, 10.9% and 29.4%; homemade pastries, 39.9% and 9.0%; ice cream and pudding, 10.0% and 15.0%; sweetened cereals and/or cereal bars, 5.4% and 6.3%; sugar-sweetened beverages, 5.7% and 8.4%; energy drinks, 1.6% and 5.0%; water, 24.1% and 8.8%; homemade meals, 48.0% and 3.1%.

lists of the 11 studies; thus, 12 studies were included in this scoping review (Figure 1).

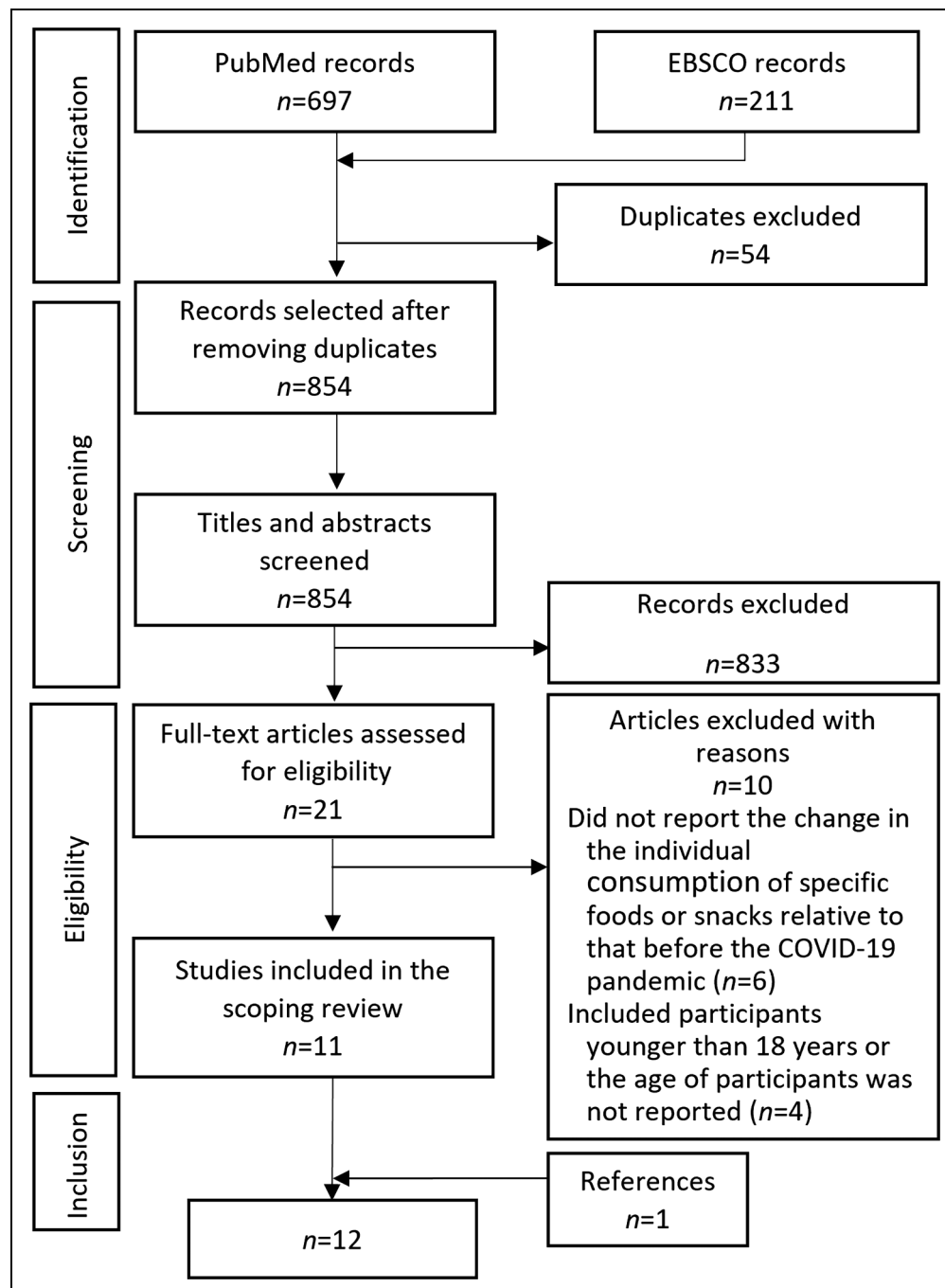
### General study characteristics

Table 1 shows the 12 studies; these were cross-sectional studies that used online surveys and were conducted in China ( $n=3$ ) (Luo et al., 2020; Wang et al., 2020; Yan et al., 2020), Spain ( $n=2$ ) (Rodríguez-Pérez et al., 2020; Romeo-Arroyo et al., 2020), Poland ( $n=2$ ) (Górnicka et al., 2020; Sidor and Rzymysk, 2020), Australia ( $n=1$ )

(Stanton et al., 2020), the USA ( $n=1$ ) (Zachary et al., 2020), Chile ( $n=1$ ) (Reyes-Olavarria et al., 2020), Spain and Greece ( $n=1$ ) (Papandreou et al., 2020), and other countries ( $n=1$ ) (Ammar et al., 2020).

### Changes in food and drink consumption

The studies reported specific dietary changes, including frequency or amount of consumption of snacks ( $n=9$ ; Ammar et al., 2020; Górnicka et al., 2020; Luo et al., 2020; Papandreou et al., 2020; Rodríguez-Pérez et al., 2020;



**Figure 1.** Flow diagram illustrating the study selection process.

Romeo-Arroyo et al., 2020; Sidor and Rzymsk, 2020; Wang et al., 2020; Zachary et al., 2020); alcohol ( $n=7$ ; Ammar et al., 2020; Górnicka et al., 2020; Rodríguez-Pérez et al., 2020; Romeo-Arroyo et al., 2020; Sidor and Rzymsk, 2020; Stanton et al., 2020; Yan et al., 2020); and vegetable and fruit ( $n=5$ ; Górnicka et al., 2020; Luo et al., 2020; Romeo-Arroyo et al., 2020; Reyes-Olavarría et al., 2020; Wang et al., 2020). Some studies reported changes in the consumption of other specific foods, such as dairy and fried foods (Górnicka et al., 2020; Luo et al., 2020; Rodríguez-Pérez et al., 2020; Romeo-Arroyo et al., 2020; Wang et al., 2020), and changes in general dietary habits (total consumption and food quality) (Górnicka et al., 2020; Papandreou et al., 2020; Reyes-Olavarría et al., 2020; Rodríguez-Pérez et al., 2020; Sidor and Rzymsk, 2020; Wang et al., 2020).

### *Frequency and amount of snack consumption*

Three of the nine studies that reported changes in snacking, reported the rates of those who increased and decreased the amount of their snack consumption (Górnicka et al., 2020; Luo et al., 2020; Romeo-Arroyo et al., 2020). One study reported that the proportion of participants who increased their sweets consumption (>50%) was higher than that of those who decreased it (<33%) (Romeo-Arroyo et al., 2020). Another study reported that the proportion of people who increased their snack consumption (18.7%) was lower than that of those who decreased it (23.6%) (Luo et al., 2020). The third study reported that the proportion of participants who had increased their confection consumption (32.5%) was higher than the proportion that had decreased it (18.8%); however, the same study reported that the proportion of people who increased their salty snack consumption (18.1%) was lower than the proportion that had decreased it (19.7%) (Górnicka et al., 2020).

Three of the nine studies reported only whether the snack consumption had increased, with the proportion of participants who increased their snack consumption ranging from approximately 30% to 65.3% (Papandreou et al., 2020; Wang et al., 2020; Zachary et al., 2020).

Among the three remaining studies, one reported whether the snacking frequency had increased or decreased (Rodríguez-Pérez et al., 2020); another examined only whether the snacking frequency had increased (Sidor and Rzymsk, 2020); and another examined the frequencies of snacking before and during the lockdown and compared them (Ammar et al., 2020). The proportion of people who had increased their snacking frequency (37.6%) was higher than that of those who decreased it (15.7%) (Rodríguez-Pérez et al., 2020); of the 51.8% of people who increased their snacking frequency (Sidor and Rzymsk, 2020), and the proportions of people who answered “always” for snack consumption between meals or a late-night snack were 15.4% and 6.4% before and during the lockdown, respectively (Ammar et al., 2020).

### *Alcohol consumption*

Seven studies reported changes in alcohol consumption, of which five examined whether alcohol consumption had increased (Górnicka et al., 2020; Rodríguez-Pérez et al., 2020; Romeo-Arroyo et al., 2020; Stanton et al., 2020; Yan et al., 2020) and three of these reported that the proportion of people who had decreased their alcohol consumption (35.9%, 57.3%, and 26.6%) was higher than those who had increased it (30.8%, 10.4%, and 18.1%) (Rodríguez-Pérez et al., 2020; Stanton et al., 2020; Yan et al., 2020). In one study, fewer participants had decreased their alcohol consumption (10.7%) than participants who had increased it (18.1%) (Górnicka et al., 2020), whereas another study reported that <50% and <33% of participants, had increased and decreased their alcohol consumption, respectively (Romeo-Arroyo et al., 2020). One study reported only the proportion of people who had increased their alcohol consumption (14.6%), but it did not examine the proportion of people who had decreased their alcohol consumption (Sidor and Rzymsk, 2020). A study reported that the proportion of people who had alcohol binge drinking was 5.4% for sometimes during the lockdown and 10.1% before the lockdown (Ammar et al., 2020).

### *Vegetable and fruit consumption*

Of the five studies reporting changes in vegetable and fruit consumption, three reported the proportion of participants who had separately increased vegetable and fruit consumption (Górnicka et al., 2020; Luo et al., 2020; Romeo-Arroyo et al., 2020); among these, one reported that <50% and <33% of participants, had increased and decreased their vegetable and fruit consumption, respectively (Romeo-Arroyo et al., 2020). In another study, 31.3% and 27.5% of participants had increased their vegetable and their fruit consumption, respectively, and despite not mentioning the proportion of those who had decreased their vegetable and fruit consumption, the “vegetables and fruits” category was included in the top 10 food categories with decreased consumptions (<12.7%) (Luo et al., 2020). A study reported that those who had increased their vegetable (18.5%) and fruit consumption (15.2%) were fewer than those who had decreased their vegetable (19.4%) and fruit consumption (20.1%) (Górnicka et al., 2020). Of the remaining two studies, one had a higher proportion of participants who had increased their vegetable and fruit consumption (30.9%) than of participants who had decreased their vegetable and fruit consumption (20.7%) (Reyes-Olavarría et al., 2020). The last study reported that >30% of the participants increased their vegetable and fruit consumption but did not report the proportion of those who decreased their vegetable and fruit consumption (Wang et al., 2020).

### *General change in dietary habits*

Four studies reported whether eating habits became healthier (Górnicka et al., 2020; Papandreou et al., 2020;



Reyes-Olavarria et al., 2020; Wang et al., 2020). In one, 23% of participants had healthier habits (Wang et al., 2020); another categorized participants into three groups by changes in dietary patterns based on changes in food and drink-consumption, including vegetables, meats, fast foods, confectionary, and alcohol consumption, reported that 27.6%, 53.0%, and 19.4% of participants had healthy, constant, and unhealthy dietary change patterns, respectively (Górnicka et al., 2020). The third study reported that 33.7% and 26.7% of participants chose, “healthier than before” and “less healthy than before,” respectively, as the general perception of diet (Reyes-Olavarria et al., 2020). The fourth study reported that the proportion of participants who chose “I plan better” regarding meal planning was 11.6% in Spain and 21.1% in Greece, whereas the proportion of those who chose “I plan worse” was 36.1% in Spain and 33.7% in Greece (Papandreou et al., 2020).

Five studies reported changes in total food consumption (Górnicka et al., 2020; Papandreou et al., 2020; Reyes-Olavarria et al., 2020; Rodríguez-Pérez et al., 2020; Sidor and Rzymysk, 2020); two reported that 36.3% and 43.5% of participants ate more (Rodríguez-Pérez et al., 2020; Sidor and Rzymysk, 2020) and three reported that 11.4–51.3% and 14.1–74.3% of participants increased and decreased their total food consumption, respectively (Górnicka et al., 2020; Papandreou et al., 2020; Reyes-Olavarria et al., 2020).

### **Health status and QOL**

Weight change was reported in 5 of 12 studies (Papandreou et al., 2020; Reyes-Olavarria et al., 2020; Rodríguez-Pérez et al., 2020; Sidor and Rzymysk, 2020; Zachary et al., 2020). Each one reported on self-reported health (Yan et al., 2020), QOL (Wang et al., 2020), and psychological distress (Stanton et al., 2020), but four did not report health status and QOL. Five studies addressed weight change: two reported how much weight the participants had gained or lost (Sidor and Rzymysk, 2020; Zachary et al., 2020). Other studies did not define the amount of weight gained or lost (Papandreou et al., 2020; Reyes-Olavarria et al., 2020; Rodríguez-Pérez et al., 2020); two studies examined only weight gain (Papandreou et al., 2020; Rodríguez-Pérez et al., 2020). Altogether, in these studies, 12.8–39.8% of participants gained weight and 14.2–19.8% lost weight (Papandreou et al., 2020; Reyes-Olavarria et al., 2020; Rodríguez-Pérez et al., 2020; Sidor and Rzymysk, 2020; Zachary et al., 2020). Reyes-Olavarria et al. (2020) reported sex-stratified weight changes.

### **Factors related to dietary changes**

Of the 12 studies, 10 reported factors related to dietary change (Górnicka et al., 2020; Luo et al., 2020; Papandreou et al., 2020; Reyes-Olavarria et al., 2020; Rodríguez-Pérez et al., 2020; Romeo-Arroyo et al., 2020;

Sidor and Rzymysk, 2020; Stanton et al., 2020; Yan et al., 2020; Zachary et al., 2020), including age (Górnicka et al., 2020; Luo et al., 2020), BMI (Górnicka et al., 2020; Sidor and Rzymysk, 2020), weight gain (Reyes-Olavarria et al., 2020; Zachary et al., 2020), psychological conditions (Papandreou et al., 2020; Romeo-Arroyo et al., 2020; Stanton et al., 2020), residence place and status (Górnicka et al., 2020; Luo et al., 2020; Rodríguez-Pérez et al., 2020), educational background (Rodríguez-Pérez et al., 2020), and COVID-19 infection risk (Yan et al., 2020). Luo et al. (2020) reported that older participants were more likely to change dietary habits, but Górnicka et al. (2020) reported that pro-healthy dietary changes were negatively associated with age, and that participants with high BMI were more likely to change to healthier diets. In contrast, Sidor and Rzymysk (2020) reported that participants with high BMI were more likely to increase food consumption and snacking. Two studies reported that participants with worse psychological conditions were more likely to increase consumption of snacks, food (Papandreou et al., 2020), and alcohol (Stanton et al., 2020). Rodríguez-Pérez et al. (2020) reported that participants who lived with children were more likely to change to healthier diets, but Górnicka et al. (2020) reported that unhealthy change patterns were positively associated with living with a partner and/or children.

### **Assessment of the methodological quality**

Of the 12 studies, each received one of these ratings depending on the evaluations they received: “Good” (if graded positively 6 or more times), “Fair” (if graded positively 3–5 times), or “Poor” (if graded positively 0–2 times) in terms of overall quality (Table 2). None of the studies selected or recruited all participants from the same population or similar populations, and none assessed the data over time. Most studies scored poorly on sample-size justification.

### **Discussion**

This scoping review summarizes the studies examining changes in food and drink consumption triggered by the COVID-19 pandemic worldwide. The 12 studies were examined and reported on various changes in food and drink consumption, such as the frequency and amount of snack, alcohol, and vegetable and fruit consumption. These changes showed both increasing and decreasing trends and were either healthy or unhealthy. Ten of the 12 studies suggested some factors of dietary changes, such as age, BMI, psychological conditions, and residence (Górnicka et al., 2020; Luo et al., 2020; Papandreou et al., 2020; Reyes-Olavarria et al., 2020; Rodríguez-Pérez et al., 2020; Romeo-Arroyo et al., 2020; Sidor and Rzymysk, 2020; Stanton et al., 2020; Yan et al., 2020; Zachary et al., 2020).

Some studies reported an increase in consumption of fruits and vegetables, whereas others reported a decrease

**Table 2.** Assessment of the methodological quality of the included studies.

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Overall quality
Luo et al., 2020	+	+	+	-	-	NA	NA	-	-	-	-	NA	NA	+	Fair
Yan et al., 2020	+	+	+	-	-	NA	NA	±	±	-	+	NA	NA	+	Fair
Wang et al., 2020	+	+	+	-	-	NA	NA	+	+	-	+	NA	NA	-	Good
Rodríguez-Pérez et al., 2020	+	+	+	-	-	NA	NA	±	-	-	+	NA	NA	+	Fair
Romeo-Arroyo et al., 2020	+	-	+	-	-	NA	NA	±	±	-	±	NA	NA	-	Poor
Papandreou et al., 2020	+	+	+	-	-	NA	NA	±	±	-	+	NA	NA	+	Fair
Górnicka et al., 2020	+	+	+	-	-	NA	NA	±	-	-	-	NA	NA	+	Fair
Sidor and Rzymysk, 2020	+	+	+	-	-	NA	NA	-	-	-	-	NA	NA	-	Fair
Stanton et al., 2020	+	+	+	-	-	NA	NA	-	-	-	+	NA	NA	+	Fair
Zachary et al., 2020	+	+	+	-	+	NA	NA	±	-	-	-	NA	NA	-	Fair
Reyes-Olavarria et al., 2020	+	+	+	-	-	NA	NA	±	±	-	-	NA	NA	+	Fair
Ammar et al., 2020	+	+	+	-	-	NA	NA	-	-	-	±	NA	NA	-	Fair

1: Objective clearly stated, 2: Population clearly specified, 3: Participation  $\geq 50\%$ , 4: Similar populations, 5: Sample-size justification, 6: Exposure assessed prior to outcome measurement, 7: Sufficient time frame, 8: Different levels of exposure, 9: Exposure measures clearly defined, 10: Exposure assessed more than once over time, 11: Outcome measures validated and clearly defined, 12: Outcome assessors blinded, 13: Follow-up rate, 14: Adjusted confounding variables.

“+” stands for a positive evaluation; “-” stands for a negative evaluation; “±” stands for a neutral evaluation; NA = not applicable. Overall quality: “Good,” “Fair,” and “Poor” when the article had more than 6, 3–5, and 0–2 positive evaluations, respectively.

(Górnicka et al., 2020; Luo et al., 2020; Reyes-Olavarria et al., 2020; Romeo-Arroyo et al., 2020; Wang et al., 2020). The decrease may be due to a difficulty in obtaining fruits and vegetables owing to unavailability or avoidance of going out to buy groceries. In contrast, increased fruit and vegetable consumption may be attributable to people having more time to prepare meals; the frequency of eating out decreased because people stayed at home longer than usual during the lockdown. A review linked higher vegetable consumption with having more free time and willingness to prepare home-cooked meals (Appleton et al., 2016).

The World Economic Forum (2020) expected people to eat fewer snacks than usual in several countries during the pandemic; however, several studies included in this review reported increased snack consumption. A systematic review found severe mental health problems among individuals and populations in strict quarantine and isolation in different contexts (Hossain et al., 2020). Moreover, perceived stress was positively associated with consumption of savory snacks (Errisuriza et al., 2016). Perceived stress management moderated the relationship between stress and sweet snacking (Errisuriza et al., 2016). Therefore, stress management during the lockdown is necessary to control binge eating of snacks.

Contrary to popular belief, multiple studies in this scoping review reported that the number of participants who consumed less alcohol was greater than those who increased their alcohol consumption. This might be due to COVID-19 contention measurements, such as restricting people from going outside or opening restaurants and limiting people's opportunities to consume alcohol at restaurants. These studies were conducted from February to May 2020 and, thus, examined the initial effects of the lockdown. Isolation during the COVID-19 pandemic possibly led to increased alcohol consumption among susceptible

individuals because long-term isolation might increase stress levels, leading to an increased craving for alcohol (Clay and Parker, 2020). Future studies should examine the long-term effects of alcohol consumption associated with the lifestyle changes due to the COVID-19 pandemic.

This scoping review suggests that the weight of most people did not change, although some did gain or lose weight. A systematic review on psychological health and PA levels during the COVID-19 pandemic found that the lockdown caused psychological distress and sedentarism (Violant-Holz et al., 2020). Al-Musharaf suggested that emotional eating was common among young Saudi women during the COVID-19 pandemic (Al-Musharaf, 2020). These changes increase the risk of obesity and have future health consequences. Weight management in consideration of mental health problems, is needed during the COVID-19 pandemic with the support of health care professionals.

Ten studies investigated factors related to dietary changes. However, in most of the results, the factors associated with positive and negative dietary changes were inconsistent. The relationship between worse mental health and increased snacking and food (Papandreou et al., 2020) and alcohol consumption (Stanton et al., 2020) were consistent.

Five studies were included (Ammar et al., 2020; Rodríguez-Pérez et al., 2020; Romeo-Arroyo et al., 2020; Sidor and Rzymysk, 2020; Zachary et al., 2020), but the remaining seven studies (Górnicka et al., 2020; Luo et al., 2020; Papandreou et al., 2020; Reyes-Olavarria et al., 2020; Stanton et al., 2020; Wang et al., 2020; Yan et al., 2020) were not included in a previous review (Bennett et al., 2021). This is because the search terms differed in the previous study. The previous review included studies that targeted all ages and did not exclude people with diseases.

This scoping review has some limitations. First, the number of included studies was limited. In this review,

only two databases were used for the searches. The searches were performed from August 6 to 22, 2020. This review was restricted to studies published in English. Some studies written in other languages and some with new insights may have been published after our search. Second, all studies included in this review conducted surveys during the lockdown, which cannot be compared with any previous event. Third, the survey methodology of the studies had some points that needed improvement, in that the survey method in all the included studies involved a self-administered online questionnaire; therefore, we could not measure the heights and weights of participants, and the available information was self-reported. The questionnaires used in the studies were limited and did not cover the dual-directional dietary change. For example, some studies examined only whether overall snack consumption increased. Fourth, because most studies conducted an online survey via social networking sites, such as Facebook, WhatsApp, and WeChat, the sample was not representative of the entire population.

The lockdown due to the COVID-19 pandemic has caused a change in dietary habits globally. This scoping review suggests that there were various changes in dietary habits, such as the frequency and amount of consumption of snacks, alcohol, and vegetables and fruits, during the lockdown. Of the 12 studies, 10 reported various factors related to changes in dietary habits, such as age, BMI, psychological conditions, and residence. Most of the included studies had some methodological issues; therefore, it is necessary to examine long-term dietary changes to develop evidence-based regulations and guidelines in the future.

### Authors' contributions

MS formulated the research question, conducted the research, and drafted the manuscript. RA and YK conducted research and reviewed and edited the manuscript.

### Availability of data and materials

No new data were created or analysed in this study. Data sharing does not apply to this article.

### Consent for publication

Not applicable.

### Ethical approval

Not applicable.


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