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Changes in Adults' Eating Behaviors During the Initial Months of the COVID-19 Pandemic: A Narrative Review

Ashlie N. Johnson, PhD, Raeven Lynn M. Clockston, MPH, BSND, Lindsey Fremling, BS, Emma Clark, MS, Pamela Lundeberg, PhD, Megan Mueller, PhD, Dan J. Graham, PhD

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Authors contact information & ORCIDs:

Ashlie N. Johnson, PhD

Assistant Professor, Linfield University

Department of Psychology

900 SE Baker St

McMinnville, OR United States 97128

770-331-5779

Ajohnson8@linfield.edu

ORCID: 0000-0002-1815-2390

Raeven Lynn M. Clockston, MPH, BSND

Colorado School of Public Health

303-724-0918

Raeven.Clockston@cuanschutz.edu

ORCID: 0000-0002-1922-2952

Lindsey Fremling, BS

Research assistant, Colorado State University

Department of Psychology

Fort Collins, CO United States 80523-1876

303-345-1316

lindseyafremling@gmail.com

Emma Clark, MS

Graduate Student, Colorado State University

Department of Human Development and Family Studies

1570 Campus Delivery

Fort Collins, CO 80523-1570

720-273-1131

emma.clark@colostate.edu

ORCID: 0000-0002-4922-7666

Pamela Lundeberg, PhD

Instructor, Colorado state University

Department of Psychology

1876 Campus Delivery

Fort Collins, CO United States 80523-1876

970-339-6205

pamela.lundeberg@colostate.edu

ORCID: 0000-0002-6075-482X

Megan Mueller, PhD

Assistant Professor, Colorado State University

Department of Food Science and Human Nutrition

1571 Campus Delivery

Fort Collins, CO United States 80523-1571

(970) 491-106

Megan.mueller@colostate.edu

ORCID: 0000-0002-4479-8144

Dan J. Graham, PhD

Associate Professor, Colorado State University

Department of Psychology

1876 Campus Delivery

Fort Collins, CO United States 80523-1876

970-491-6561

Dan.graham@colostate.edu

ORCID: 0000-0001-9993-2585

Authors contribution:

AJ, RC, LF, and EC collected and analyzed articles and wrote the first draft with contributions from PL, MM, and DG.

Corresponding author and reprint contact: Ashlie Johnson, ajohnson8@linfield.edu

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Changes in Adults' Eating Behaviors During the Initial Months of the COVID-19 Pandemic: A Narrative Review

Research Snapshot

Research Question: Did adults' amount, frequency, and timing of eating, types and healthfulness of foods consumed, occurrence of specified eating behaviors (e.g., binging), and reasons for eating change during the early COVID-19 pandemic?

Key Findings: Many eating behaviors remained stable. When changes occurred, eating more likely increased in amount/frequency. Changes in when and how healthfully individuals ate showed mixed results. Consumption of some foods decreased (e.g., meat); others increased (e.g., fruits). Binging, out-of-control eating, and overeating increased, meal skipping decreased, and restrictive eating had mixed results. Dietary changes were related to changes in mood and environment.

Abstract

Factors such as regulations and health concerns shifted daily habits, including eating behaviors, during the early months of the COVID-19 pandemic. This comprehensive narrative review synthesizes research on eating behavior changes during the early months of the COVID-19 pandemic (February-June 2020) including changes in amount, rate and timing of food consumption, types and healthfulness of foods consumed, the occurrence of other specified eating behaviors (e.g., restrained eating, binging), and reasons for eating (e.g., stress, cravings), among adults. A literature search using three EBSCOhost databases and Google Scholar was conducted to identify relevant articles made available in 2020. A total of 71 articles representing 250,715 individuals from over 30 countries were reviewed. Findings show eating behaviors changed little during the early pandemic for most participants. Among those whose eating

behaviors changed, increases in both intake and frequency of eating meals and snacks were more common than decreases. Findings on timing of eating and healthfulness of food consumed showed mixed results. However, when changes occurred in the type of food consumed, increases were more common for snacks, homemade pastries, white bread/pasta, legumes, and fruits/vegetables; decreases were more common for meats, seafood/fish, frozen foods, fast food, dark breads/grains, and dark leafy green vegetables. During the pandemic, binging, uncontrolled eating, and overeating increased, meal skipping decreased, and restrictive eating had mixed findings. Changes in factors such as emotions and mood (e.g., depression), cravings, and environmental factors (e.g., food insecurity) were related to changes in eating behaviors. Findings can inform clinical practitioners in efforts to mitigate disruptions to normal, healthy eating patterns among adults both in and outside of global health catastrophes.

Introduction

The COVID-19 pandemic caused an unprecedented upheaval of daily routines for individuals around the globe. Government efforts to mitigate the spread of COVID-19 have encompassed an array of responses including mass quarantines, stay-at-home restrictions, closures of schools and businesses, and shutdowns of public transportation.

Like many other health behaviors, eating is heavily dependent on habit[1,2] and, as such, has been significantly disrupted by COVID-19 and the restrictions used to quell outbreaks.[3] For example, during the COVID-19 pandemic, 51% of individuals in the United States (US) made the transition to working from home, thereby increasing their proximity to a primary food environment for longer periods throughout the day.[3,4] Additionally, unemployment in the US rose from 3.5% to 14.7% during the early phase of the pandemic (between February and April of 2020),[5] which for some individuals led to both a greater time spent at home and decreased purchasing power for balanced diets.[6,7] However, for some individuals living in low-income households, the addition of unemployment benefits and federal supplements exceeded their prior wages.[8]

The closure of restaurants shifted meal sources, often leading to an increase in cooking behaviors, while the closure of schools produced issues of food access and insecurity for communities facing economic hardship and marginalization.[9,10] Moreover, social isolation efforts and fears around virus exposure limited access to supermarkets and other food retailers.[11,12] While some individuals utilized online ordering, curbside pickups, and food/grocery delivery services to curtail these impacts, these services are not locationally or financially accessible to many individuals around the globe.[13,14]

Stockpiling behaviors and breakdowns in the food supply chain also had an impact on peoples' eating behaviors during the pandemic.[13,15] For those who could afford to stockpile food during the pandemic, stockpiling increased their access to the food around them and impacted the types of food they purchased; for those who could not afford to stockpile food during the pandemic, others' stockpiling limited the amount of food available to them.[13,16] Breakdowns in the supply chain also contributed to limitations in the food available during the pandemic.[15]

Beyond the regulatory, geographic, and financial obstacles impacting eating behaviors during the COVID-19 pandemic, many people have faced psychological and social stressors that can impact their relationship with food and the food environment.[17] A large body of literature shows the impact of emotion, stress, and mood states – both positive and negative – on food selection and eating behaviors.[18–20] Depression, stress, and boredom, among other possible reactions to pandemic-induced lifestyle changes, are related to increases in food intake and frequency of eating as well as increases in consuming higher energy foods such as sweets, snacks, and fast food.[21]

However, it is unclear how eating behaviors have changed around the globe during the COVID-19 pandemic. For instance, while many factors seem to indicate a trend toward less healthful eating behaviors, it is possible that food selection and healthfulness could improve with increased time available for cooking.[22] Moreover, evidence suggests that the best time to change habits is when other habits are changing as well,[23,24] making the abrupt changes generated by stay-at-home orders fertile ground for eating behavior change among other health behavior changes.

Comparisons across similar public health crises and national disasters such as hurricanes and earthquakes show that eating behaviors are vulnerable to change during times of regional or

international distress.[25,26] Widespread crises disrupt food systems and the economies that allow individuals to purchase food, often leading to reduced food security and increased malnutrition.[27] Moreover, the heightened stress is related to decreased fruit and vegetable intake and, among emotional eaters, overeating behaviors.[26] In fact, watching news related to disasters such as earthquakes[28] or even reading narratives about devastating hurricanes[29] is associated with changes in eating behavior. Given the ubiquitous impacts of the COVID-19 pandemic and the concomitant alterations of stress and other mood states, it is plausible that eating behaviors would change as a result.

Eating behaviors during the COVID-19 pandemic are a critical area of study given the clinical relevance of over- and under-nutrition, both of which could result from dietary changes brought about by the pandemic. Researchers suggest that nutrition can be a key factor in COVID-19 immunity[30,31] and predict that the pandemic will continue to cause a nutritional crisis given factors like job loss and the closing of public food supports.[32]

While several mini-reviews have communicated breaking findings throughout the early COVID-19 pandemic timepoints, as of this writing no review comprehensively captured the dietary impact of COVID-19 on a global scale.[33–37] Moreover, recent reviews assessing eating behaviors are narrower in scope, with specific focus areas such as weight changes[38] and feeding children.[39]

This narrative review offers a summary of key research question findings regarding changes in eating behaviors during the COVID-19 pandemic. Further, challenges to empirically studying eating during a pandemic, areas for future examination, and clinical implications are discussed.

Specifically, this review aims to address how the following eating behaviors compared during the early stages of the COVID-19 pandemic relative to before the pandemic began: the amount, frequency, and timing of food consumption, the types and healthfulness of foods eaten, the occurrence of specified eating behaviors (e.g., restrained eating, binging), and reasons for eating (e.g., emotions, cravings, environmental factors).

The scope of this review includes international research published in English and made available in the year 2020 with samples that generalize to adults who have not been diagnosed with eating disorders. The aim is to characterize early-pandemic dietary changes for populations of individuals without pathological eating behaviors around the globe.

Methods

An initial literature review assessing extant systematic, narrative, and scoping reviews of changes to eating behaviors during the COVID-19 pandemic was conducted in October 2020 using multiple EBSCOhost databases, including Academic Search Premier, Psychology and Behavioral Sciences Collection, and APA PsycInfo in addition to the Google Scholar database. Search terms included “eat*,” “COVID-19,” "coronavirus," "pandemic" and “review.” Five reviews were identified.[33–37] Some of these reviews assessed eating behaviors in addition to other health behaviors such as sleep[33,34] and physical activity.[33,35] Given the rapidly evolving context and continued influx of eating-behavior-related studies, the need for a more comprehensive narrative review was apparent. The present review contributes a global perspective and covers a more extensive range of eating behaviors than previous studies. To set the scope of the review, all relevant articles written in English and published or made available online in the year 2020 were screened for inclusion.

Article identification and selection started in October 2020. Searches were performed using the same databases as the initial literature review and the search terms "COVID," "COVID-19," "sars-cov-2," "coronavirus," "pandemic" AND eat*, nutri*, "food", diet*, grocer*. Additionally, sources referenced in articles accumulated during the database search were assessed and included as appropriate. Filters were applied to limit results to articles made available in 2020, and the final search for this review was conducted on February 8, 2021.

Article abstracts were screened to ensure relevance to eating behaviors during the early COVID-19 pandemic, especially during or following a period of lockdown and social distancing. The circumstances related to lockdowns varied globally, including the timeframe and extent of closure, so this was defined in each article relative to the geographic location and study population. A total of 138 relevant articles were gathered and assessed in their entirety for inclusion.

A final sample of 71 articles with 250,715 participants remained after 67 articles were eliminated. Studies were excluded if they: (a) did not measure or explicitly evaluate change in eating behaviors, (b) focused on child and adolescent populations exclusively, (c) focused on elderly populations exclusively, (d) focused on individuals with eating disorders or other health conditions exclusively, (e) were archival, not cross-sectional or not longitudinal, and (f) had not yet published preprints of their full articles. Please see Figure 1 for a detailed visual summary of the articles included and excluded from the present study.

Results

The 71 studies with 250,715 participants included in the final review consist of findings from 32 countries with the United States (US; n=11), the United Kingdom (UK; n=8), Italy (n=5), Spain (n=5), and Turkey (n=5) being the most studied. There were potentially more than

32 countries represented in these articles as some samples were listed as coming from locations such as "Europe," "Northern Africa," or simply "Other." Most studies were cross-sectional (66 studies; 93%), but 5 (7%) featured longitudinal designs. Nearly all studies (69; 97%; two were unspecified) reported on data collected between March 2020 and June 2020. Table 1 categorizes articles by study outcomes and provides a summary of study characteristics.

Changes in Amount of Food Consumed

A total of 24 studies addressed changes to total food intake during the COVID-19 pandemic.[13,40–62]

Twelve studies conducted in Poland,[44,62] Italy,[46,55] the UK,[45] the Netherlands,[56] Spain,[52,54] Greece,[54] Chile,[58] Saudi Arabia,[43] Germany,[50] and the United Arab Emirates (UAE)[57] assessed self-reported changes in quantity of food consumed during (vs. before) the pandemic using bipolar scales and response options including decreased, no change, and increased.[43–46,50,52,54–58,62] Given the synonymous nature of the items used, an aggregated analysis was conducted to capture the composite trends across studies (n= 14,401; see Table 2).

Across studies included in the aggregated analysis, the largest proportion of participants (44.9%) reported no change in their food intake during the pandemic. The next largest group of respondents (31.0%) indicated an increase in food intake, and the third largest group indicated decreased intake (24.1%). Results from Chenarides et al. (2021) were excluded from the analysis because the item measuring changes in the amount of food consumed included additional response options related to healthy eating and allowed respondents to select multiple answers.[13] The question *how much has your diet changed since COVID-19 started* included the following response options: *ate less, ate about the same, ate more, ate less healthy,* and *ate more healthy.* Though excluded, the findings roughly mirrored the general pattern with 59.0% reporting they

ate about the same diet, 21.4% reporting they ate more, and 13.5% reporting they ate less since COVID-19 started.[13]

It should be noted that the Papandreou et al. (2020) study results differed considerably from the other studies that examined change in consumption quantity, with most respondents (69.2%) in this particular sample reporting a decrease in total intake.[54] When this study's results are not included in the analysis, 49.1% of respondents report no change in intake, 33.4% report an increase, and 17.5% report a decrease. See Table 3 for measures and finding for all studies not included in the aggregated analysis.

Six studies used unipolar measures assessing only whether participants were eating more during (relative to before) the pandemic.[41,42,51,59–61] Most studies using this type of measure found high proportions of individuals responding "yes" to increased consumption. The highest percentage of individuals reporting more food intake came from a sample of adults in Al Madinah city, Saudi Arabia, with 63% reporting increased food intake.[41] A study of Portuguese adults had the lowest reported increase with only 31.6% of individuals responding that they ate more during the pandemic.[42] A study based in Italy showed nuanced reporting of increased food intake, with 46.1% reporting "Yes, a bit more" and only 6.8% reporting "Yes, much more."[59] This distinction in the reported amount of increase highlights a key limitation of self-reported responses for food consumption; for most measures, it is unclear how much of an increase over normal habits respondents are indicating with their "yes" responses. Different perceptions and responses to forced-choice, binary appraisals of food consumption may lead to a distortion in the overall trends regarding food intake behaviors.

One study from Kenya and Uganda measured whether people ate less.[40] Significant increases in the amount of people reporting eating less food than they thought they should were

found in the total sample (54% during the COVID-19 period, 23% during normal periods) and both subsamples (Kenya: 56% during COVID-19 period, 24% during normal periods; Uganda: 48% during COVID-19 period, 19% during normal periods). This question was part of a food insecurity questionnaire which, taken all together, showed significantly lower rates of food security during the COVID-19 period compared to normal periods before the pandemic.[40]

While the remaining four studies used unique measure formats or populations to study changes in food intake, results aligned with the findings obtained via the other measurement strategies. One study of Canadian families showed that the most common eating behavior change was an increase in eating, reported among 57% of mothers, 46% of fathers, and 42% of children.[47] Two studies used validated measures of energy intake. One found that on average, French participants reported eating significantly more (~235 kcal/day) during the first month of lockdown compared to the month before.[53] Similarly, a longitudinal study of Australian adults showed that among females there was a significant increase (19.5%) in average 24-hour energy intake compared to reported levels from 2018 and 2019.[48] Lastly, Herle et al. (2021) gathered longitudinal data to assess changes in eating behaviors over the first 8 weeks of lockdown.[49] Using latent profile analyses, they found the most common profile response (64%) to be one of no change in eating behaviors, followed by 16% reporting persistently eating more. About 9% reported persistently eating less, while 8% showed an initial increase followed by a steady decrease and 4% reported no changes in the first week and then a steady increase in consumption over time.[49]

Changes in Eating Frequency and Timing

Eating frequency in the context of the present review relates to the number of total meals and snacks consumed daily, and whether this number has changed under the circumstances of the

pandemic and the associated periods of home confinement that occurred globally. In total, 20 articles discussed the frequency of eating.[41,42,44,48,52,54–56,60,61,63–72] Timing involves the intake of meals and snacks as it relates to the respondent's typical eating schedule over a 24-hour period. There were three articles that presented evidence of how meal timing has been impacted by the COVID-19 pandemic and the resulting disruptions to routines, patterns, and schedules.[54,56,73] Meal skipping was determined to be a distinct, specified behavior and is thus covered in a later section.

See Tables 4 and 5 for overviews of findings and measures used.

Frequency of meals and snacks

Meals. The predominant trend of the 13 studies reviewed[41,42,44,52,54,64–67,69–72] was no change in the number of meals individuals reported consuming during the COVID-19 pandemic compared to prior.[42,54,67,69,71,72] For example, the majority of cross-sectional study participants in Turkey (71%),[71] China (60%),[72] and Italy (58%)[67] reported no change in the number of meals consumed.

When the number of meals eaten throughout a given day did change, it largely increased.[41,44,52,64–66,70] For example, an international survey with participants predominantly representing Western Asia, Northern Africa, and Europe found that the number of meals consumed per day significantly increased during the home confinement period ($t = -5.83$, $p < 0.001$, $d = 0.22$).[64] Specifically, there were increases in the number of participants consuming 4 meals, 5 meals, and more than 5 meals during confinement compared to prior to confinement. Similarly, studies in the UAE and Middle East and North Africa (MENA) regions found increases in the number of meals consumed per day with those consuming five or more meals per day increasing significantly.[65,66] Furthermore, a study of Spanish adults found that the "pattern"

of number of meals among the study population changed with more people consuming five meals a day during confinement (23%) compared to before (1%).[52]

A UK-based study (n= 2,002) found that 44% of respondents increased meal frequency (26% reported a little more, 14% more, and 4% a lot more) followed by 34% reporting they ate the same number of meals.[70] These data once again illustrate the nuances in the magnitude of changes in the number of eating occasions that are not visible in measures that only consider overall increase or decrease.

The remaining studies evaluated frequency of meals utilizing measures that are less common in the literature. One study of 1,404 adults in Portugal reported that 55% of participants did not eat at a higher frequency; however, the extent to which eating frequency stayed the same or decreased is unclear.[42]

Snacks. Across the 12 studies that assessed snacking frequency[44,48,54–56,60,61,63,64,68,70,71], most found that individuals either reported an increase[44,55,60,64,70] or no change[61,63,71] in snacking frequency. For example, increased snacking was reported by 56% of a sample from the UK (27% a little more, 21% more, 8% a lot more),[70] 51.8% of a sample from Poland,[60] and 32.7% of a sample from Italy (28.0% indicated they don't consume snacks usually, and 28.0% reported no change).[55] Similarly, international samples from Western Asia, Northern Africa, and Europe reported a significant increase in the number of snacks and the proportion of participants snacking between meals or late-night snacking during home confinement compared with snacking behavior prior to the pandemic ($t = -6.89$, $p < 0.001$, $d = 0.30$).[64]. Further, while studies from Turkey,[71] Denmark,[61] and Qatar[63] found that the most common response was no change (57.5%, 47.5%, and 45.5% respectively), a large proportion of the samples also reported increased snacking (38%, 41.7%, and 35.3%, respectively).

Two studies assessed how the relationship between COVID-19 confinement and snacking frequency might be modified by other factors such as gender and snack healthfulness.[48,68] One longitudinal study of university students in Australia found that levels of snacking were no different between 2018, 2019, and 2020 samples of men, but snacking increased among women.[48] Additionally, in a study focused on Australia, the US, the UK, and Canada, 25.8% of participants reported an increase in healthy snacking, while 43.5% of participants reported an increase in unhealthy snacking.[68]

Two studies measuring snacking frequency found snacking did not increase among their participants; however, the survey did not differentiate whether a 'no increase' response meant that the respondents were eating the same amount as before or less than before.[54,56] For example, one study reported that only 34.1% of a Spanish sample and 40.8% of a Greek sample answered "yes" to a measure of increased snacking.[54]

Timing of meals and snacks

There is limited evidence available illustrating how timing of eating has been impacted by the COVID-19 pandemic. Three studies asked participants to indicate how their eating routines had changed during confinement compared to before.[54,56,73] In a study of adults from India (n=422), 50.2% of respondents reported their eating schedule did change, and 11.1% reported that their schedule might have changed.[73] Papandreou et al. (2020) and Poelman et al. (2021) both included measures of meal timing but did not explicitly ask their participants how they modified their meal schedules.[54,56] As previously mentioned, Papandreou et al. (2020) measured frequency and timing in the same question. They report that 59.8% of the sample from Spain and 51.7% of the sample from Greece did maintain the same hours and numbers of meals

during the pandemic.[54] Additionally, 16.9% of participants from the Netherlands reported that they "ate at different times" during the lockdown period.[56]

Changes in Consumption of Specific Food Types

A total of 38 articles reported on changes in the consumption of specific foods.[13,40,43–45,47,48,50,51,54,55,57–59,61–63,65–69,71,74–88] Through a thematic analysis of major food categories assessed, this review summarizes trends in consumption for the following: fruits and vegetables, breads and grains, meats and seafood, legumes, frozen foods, homemade foods, fast food, "snack" foods, and sweets and/or bakery products. See Table 6 and Table 7 for a summary of measures and findings.

Fruits and Vegetables

Thirty-one studies examined how the consumption of fruits and vegetables changed during the pandemic; 12 studies examined the consumption of fruits and vegetables together[13,43,47,55,58,59,63,75,79,81,86,87] while 20 studies examined fruits separately from vegetables.[40,44,45,50,51,61,62,67–69,71,76–78,80–85] One of these studies examined fruits and vegetables both together and separately.[81]

Of the 12 studies that measured fruit and vegetable consumption together using a single-item measure (increased, decreased, or remained the same during the pandemic), six studies from Brazil, Qatar, the US, the UK, Canada, Italy (2 studies), and Chile found that the largest group of participants (48.4%-69.2%) reported that their consumption of fruits/vegetables did not change during the pandemic.[13,55,58,59,63,75] The second most common response (22.1%-32.4%) was an increase in fruit/vegetable consumption.[13,55,58,59,63] Increased consumption was the most common response in studies from Saudi Arabia and Spain[43,79] and a decrease in consumption was the primary finding for studies from Brazil, Zimbabwe, and the US.[81,86,87]In one study from Canada

more fathers and children reported eating more (fathers: 32%, children: 24%) rather than less (fathers: 12%, children: 20%) fruits and vegetables during the pandemic; however, more mothers reported eating less (mothers: 22%) rather than more (mothers: 20%).[47]

Fruits. Of the 20 studies investigating fruit consumption independently, ten used a single-item measure (i.e., increased, decreased, or remained the same).[45,50,51,61,62,71,76,81,83,84] Seven of these ten studies (from Poland, Denmark, Spain, Lithuania, Germany, Turkey, and the US) found that the largest group of participants (49.4%-68%) reported no change in fruit consumption during the pandemic.[50,51,61,62,71,76,84] An increase in consumption was the second most frequently reported response (18%-49.1%) for four of these studies[50,51,71,84] whereas a decrease was second most common (20.1%-33.4%) in three studies.[61,62,76] One study conducted in the UK primarily found an increase in consumption[45] and one study from Zimbabwe reported decreases.[81]

However, results suggest possible nuances in fruit consumption rates. For example, while fruit consumption in one study of Iranian adults was not significantly different before vs. during the early pandemic, the researchers found a 2.8% increase in families who reported consuming "vitamin A-rich fruits" during the pandemic and a 2.2% decrease in families who reported consuming "fruits" during the pandemic.[83]

Findings from studies using other measures of fruit consumption confer mixed results, including studies from Italy, Brazil, Kenya/Uganda, and Canada showing that fruit consumption decreased for more respondents than it increased,[40,67,78,80] studies from the US/UK/Australia/Canada/other, Kuwait, Nigeria, Island of Ireland/Great Britain/US/New Zealand, and Spain showing the opposite pattern,[68,69,77,82,85] and a study from Poland showing no change overall.[44]

Vegetables. Nine of the 20 studies investigating vegetable consumption used a single-item measure (i.e., consumption increased, decreased, or remained the same).[45,50,51,61,62,71,76,81,84] Of these nine, six studies out of Lithuania, Germany, Denmark, Poland, Spain, and Turkey found that the majority of participants (53.5%-71%) reported no change in their overall vegetable consumption during the pandemic[50,51,61,62,71,84] with the second most frequently reported option being increased consumption (17%-40.5%) in four studies[50,51,71,84] and decreased consumption (19.4%-19.5%) in two studies.[61,62] The primary findings of studies from the UK and Canada were increases in consumption.[45,78] Three studies from Iran, the US, and Zimbabwe assessed specific vegetables with most reporting no change in consumption (i.e., for vitamin A-rich vegetables, tubers, starchy and non-starchy vegetables, dark green leafy vegetables and "other" vegetables) or decreased consumption (i.e., for dark green leafy vegetables, vegetables in general).[76,81,83]

Research using other measures of vegetable consumption is similarly mixed, with two studies from Poland and US/UK/Australia/Canada/other reporting no change,[44,68] three studies from Kuwait, Kenya/Uganda, and Brazil reporting decreases,[40,69,80] and four studies from Italy, Nigeria, Island of Ireland/Great Britain/US/New Zealand, and Spain showing increases.[67,77,82,85]

Bread and Grains

Eleven studies examined how the consumption of bread, grains, and/or cereals changed during the pandemic.[13,44,50,55,62,67,69,76,78,81,83]

Five studies from Poland, the US, Italy, Germany, Kuwait looked at how the consumption of bread changed during the pandemic and results varied by bread type.[44,50,67,69,76] When just asked about bread consumption in general, most participants reported either no change or increased consumption.[50,67] White bread consumption tended to either remain stable or

355 increase.[69,76] One study based in Poland found no change in the frequency of consumption of
356 white bread, but a significant decrease in the portion size of white bread.[44] Dark and
357 brown/brown seed bread tended to either remain stable or decrease.[69,76]

358 Considering grains, consumption tended to remain the same.[13,44,62,78] Studies based in
359 Poland and the US found that the highest portion (59.35%-72.3%) of participants reported no
360 change in their consumption of grains and whole grains.[13,62] Similarly, one Polish study found no
361 significant change in the consumption of buckwheat oats.[44] Conversely, a study based in Canada
362 found that there was a significant decrease in the consumption of refined grains and a significant
363 increase in consumption of whole grains.[78]

364 Four studies asked participants about their consumption of cereals (i.e., pasta,
365 rice).[55,67,81,83] Two studies from Iran and Italy found that consumption of cereals did not
366 change.[55,83] When consumption did change, results were mixed, with one study from Italy
367 finding that more people reported increased intake (24.7%) than reduced intake (5.3%)[67] and one
368 study from Zimbabwe reporting that the highest portion of participants (41.7%) had a decreased
369 consumption of cereals, breads, and tubers.[81] One study from the US found that white rice or
370 pasta was either unchanged (62.5%) or increased (26.8%) and brown rice or whole-grain pasta
371 was either unchanged (76.8%) or decreased (15.1%).[76] Similarly, a study from Poland found no
372 significant change in the consumption of white rice and white pasta.[44]

373 ***Meats***

374 A total of 20 studies examined how the consumption of various types of meat changed
375 during the pandemic.[13,40,43,44,50,51,55,61–63,67,69,71,76–78,81,83–85] Overall, meat consumption remained
376 the same as pre-pandemic levels or decreased.

Nine of the 20 studies asked participants about how their consumption of meat in general changed during the pandemic.[13,40,43,50,55,63,77,78,81] Studies from Qatar, Germany, Zimbabwe, the US, Saudi Arabia, and Italy found that for the majority of participants (45.9%-72.6%) consumption did not change.[13,43,50,55,63,81] The second most common response for studies from the US, Germany, Qatar, Zimbabwe was decreases in meat consumption.[13,50,63,81] The second most common response for studies in Saudi Arabia[43] and Italy[55] was increases in protein consumption, though the study from Italy included non-meat proteins. One study from Canada also found increases in protein consumption, including non-meat sources.[78] On the other hand, studies from Kenya, Uganda, Nigeria found that fewer respondents reported frequent consumption of meat during the pandemic (16%-22.4%) than before the pandemic (41.6%-51.2%)[40] and fewer participants reported having a preference for meat during (22.9%) compared to before the pandemic (29.2%).[77]

Six studies based in Poland, the US, Kuwait, and Italy assessed changes in the consumption of processed meat during the pandemic and found that the majority of participants reported no change.[44,61,62,67,69,76] When consumption did change, there were both increases[44,69,76] and decreases[62,67] reported.

Six studies conducted in Poland, Italy, Denmark, Lithuania, Kuwait, and Spain investigated how the consumption of red meat changed during the pandemic.[44,51,61,67,69,84] The most common result was no change in red meat consumption; however, when red meat consumption did change, it tended to decrease.[44,51,61,67,69,84]

Three studies from Kuwait, the US, and Kenya/Uganda[40,69,76] examined how the consumption of poultry products changed during the pandemic, with results indicating no change[76] or decreases in consumption.[40,69]

Of the more specified measures of meat consumption, no change in intake was the most common response for low-fat meats (Poland),[62] flesh meats (Iran),[83] "red meat, chicken, and fish" (Turkey),[71] and "beef, pork, or lamb" (US)[76].One study in Italy found that more participants reported an increased consumption of both white meat and preserved meat than a reduced consumption[67] and one study in Spain found that there was an increase in the percentage of participants who reported consuming two or more portions of "red meat, hamburgers, sausages, or cold meats" per day during the pandemic (17.3%) compared to 12.9% who did so before the pandemic.[85] Conversely, one study in Iran found a significant decrease in the consumption of organ meats.[83]

Fish and/or Seafood

A total of 13 studies measured changes in consumption of fish and/or seafood during the pandemic.[40,44,51,61,62,67,69,76,78,83–85,88] Studies from Poland, Denmark, Spain, Lithuania, Iran, and the US found that the majority of participants (68.4%-78.3%) reported that their consumption of fish and/or seafood remained the same during the pandemic.[44,51,61,62,76,83,84] When consumption did change, it tended to decrease (14.3%-21%).[51,62,76,84] In fact, studies from Kuwait, China (longitudinal), Kenya, and Uganda found that a decrease in consumption was most common.[40,69,88] However, increases in consumption were also reported in Canada and Spain.[78,85] One study from Italy found that consumption changed by type of fish with an increase in preserved and frozen fish intake and a decrease in fresh fish intake.[67]

Legumes

Eleven studies examined changes in the consumption of legumes during the pandemic.[44,51,55,61,62,67,80,81,83–85] Overall, findings from Poland, Denmark, Spain, Lithuania, Turkey, and Zimbabwe suggest that intake of legumes remained at similar levels during

compared with before the pandemic,[44,51,61,62,71,81,84] although several studies (in Spain, Italy, and Iran) did report increased consumption,[67,83,85] and one study (in Brazil) reported a decrease.[80] One study from Italy looked at proteins and included in this list was meat, fish eggs, cheese, and legumes.[55] They found that for most participants (54%) protein consumption was unchanged, with the second most common response being increased consumption (27.3%).[55]

Frozen Foods

One longitudinal study[88] from China and five cross-sectional studies[13,63,65,66,80] from the US, Qatar, UAE, MENA, and Brazil measured changes in frozen food consumption with mixed results suggesting an overall decrease[66,88] or no change in intake.[13,63,65] Conversely, in one study out of Brazil there was an increase in participants who reported consuming ready-to-eat frozen food (e.g., frozen pizza, frozen lasagna) more than two days a week during (14.6%) compared to before (10.0%) the pandemic.[80]

Fast Food

Ten studies examined how the consumption of fast food changed during the pandemic.[13,44,47,51,61,62,65,66,68,84] Overall, consumption tended to remain the same[51,61,62,84] or decrease[13,44,65,66,68] in countries including the US, UK, Australia, UAE, MENA, Poland, Denmark, Spain, and Lithuania. In one study from Canada more people reported eating less (mothers:42%, fathers: 44%, children: 26%) rather than more (mothers:10%, fathers: 13%, children: 8%) fast food during the pandemic.[47]

Homemade Foods

Eight studies examined changes in consumption of homemade foods during the pandemic.[51,58,61,62,65–67,74] In contrast to all other food categories, the overall consumption of homemade foods tended to increase during the pandemic; two studies found increases in the

446 percentage of participants that reported homemade meals as one of their most consumed meals
447 (MENA and UAE).[65,66] One study found a significant increase in the frequency of eating home-
448 cooked meals (Saudi Arabia) and one study found that the majority of participants (59.6%)
449 reported cooking at home more than before the pandemic (Chile).[58,74] Furthermore, a study in
450 Poland found the largest group of participants (48.8%) reported that their consumption of
451 homemade meals remained the same; the second most endorsed option was nearly as common
452 and was increased intake (48.0%).[62]

453 Considering specific homemade foods, three studies from Poland, Denmark, and
454 Lithuania found most participants (50.8%-53.8%) reported no change in their consumption of
455 homemade pastries; however, a considerable percentage of participants (37.7%-39.9%) reported
456 an increase.[51,61,62] Further, in a study out of Italy, more participants reported increased than
457 decreased consumption of both homemade sweets and homemade pizza.[67]

458 ***Snack Food***

459 Eighteen studies assessed how the consumption of snack foods changed during the
460 pandemic.[43,45,47,48,51,54,55,57,59,61–63,67,71,76,80,84,88]

461 One longitudinal[48] and eight cross-sectional[43,47,51,54,55,61,71,84] studies showed that when
462 measured as an overall category, snack food intake tended to increase or remain stable in
463 Australia, Saudi Arabia, Canada, Lithuania, Spain, Greece, Italy, Denmark, and Turkey.

464 Considering specific snack foods, two studies conducted in Poland and the US examined
465 consumption of salty snacks (i.e., potato chips, crackers, popcorn)[62,76] and one study from Italy
466 assessed salty and sweet snacks together.[59] In the three studies, most participants (49.6%-62.2%)
467 reported that their consumption of salty snacks was unchanged.[59,62,76] The second most common
468 response was increased consumption (23.5%-37.4%) in the studies from Italy[59] and US[76] and

decreased consumption (19.7%) in the study from Poland .[62] One study asked only about increased consumption with 21% of respondents from the UAE reporting increased salty snack intake.[57] However, results from a study conducted in Italy show more participants reported a reduced intake (12.7%) compared to an increased intake (9.3%).[67]

Considering savory snacks (i.e., peanuts or other nuts, cream crackers, cheese biscuits and cheese, chips, salty biscuits), consumption tended to remain the same or increase.[45,80] Two studies found the highest proportion of participants (40-49%) reported no change in consumption[43,45] with the second highest portion of participants reporting increased consumption (28%) in the UK[45] and equal portions reporting decreased consumption (30%) and increased consumption (30%) in Saudi Arabia.[43](Additionally, a Brazilian study found more participants reported consuming savory snacks more than two days a week during the pandemic (13.2%) compared to before the pandemic (9.5%).[80]

Two studies measured changes in consumption of sweet snacks (i.e., chocolate, biscuits, cakes, ice cream, cupcakes, cookies).[45,57] One study from the UK found the highest portion of participants (46%) reported that their consumption was unchanged, and the second most common response (28%) was that consumption of sweet snacks increased.[45] Another study from UAE found that only 7.1% of participants reported consuming more sweet snacks during vs. before the pandemic.[57]

One study from Qatar assessed snack consumption as the change in intake for both healthier snack foods and unhealthful snacks and found the largest portion of participants (41.1%-57.7%) reported no change in consumption regardless of healthfulness.[63] When consumption did change, it tended to increase for healthy snacks (20.9%) and decrease for unhealthy snacks (32.4%).

Finally, a longitudinal study from China examined the consumption of snacks and beverages together and found most participants reported either stable (38%) or decreased consumption (38%).[88]

The results of all 18 studies that measured changes in snack food consumption indicate that, in general, the consumption of snack foods either remained the same or increased during the pandemic. The magnitude of the increased consumption was dependent on the type of snack food.

Sweets and/or Bakery Products

A total of 19 studies examined how the consumption of various types of sweets and/or bakery products changed during the pandemic.[43,44,50,51,54,55,59,61–63,67,68,76–78,80,83–85] Overall, consumption of sweets and/or bakery products tended to either remain the same or increase.

Ten of the 19 studies asked participants about pandemic-related changes in their consumption of sweets in general or as a combined list of sweet foods (i.e., a single item with multiple sweets listed).[43,44,55,59,63,67,68,76,80,83] Studies from Saudi Arabia,[43] Poland,[44] Brazil,[80] Italy,[55] and a large international sample (US/UK/Australia/Canada/Other)[68] found the most common response was an increase in sweet consumption (44%-50%). One study from the US, found nearly equal proportions of participants reporting increased (43.9%) or no change (43.5%) in consumption.[76] Studies from Qatar[63] and Italy[59] found the most common response was no change in consumption (43.3%- 44%). Of these studies, the second most common response was decreased consumption (28.7%) for one study[63] and increased (42.5%) for the other.[59] Finally, one study from Iran found that there was a significant decrease in sweet consumption[83] and one study from Italy found more participants reported a reduced intake (16.7%) compared to an increased intake (11.3%) of sweets during the pandemic.[67]

Five studies based in Denmark,[61] Poland,[62] Spain/Greece,[54] Spain,[84] and Lithuania[51] assessed changes in the consumption of pastries during the pandemic. For most participants (55.2%-60.6%) consumption was unchanged.[51,61,62,84] Similarly, when asked if they consumed more pastries during the pandemic, 69.4% of participants from Spain and 62.2% of the participants from Greece responded they had not.[54] When consumption did change there were both reported increases[61,84] and decreases.[51,62]

Two studies from an international sample (Nigeria/Turkey/US/Europe)[77] and Spain[85] examined how the consumption of bakery products in general changed during the pandemic. One found fewer participants reported preferring bakery foods during the pandemic (10%) compared to before (20%).[77] The other study found a significant increase in the consumption of bakery foods during the pandemic.[85]

Two studies from Poland[62] and Germany[50] examined how the consumption of confectionaries changed during the pandemic. The largest group of participants from Germany (44.5%) reported increased consumption[50] while the largest group of participants from Poland (48.7%) reported no change in consumption.[62]

Two studies assessed more specified measures of sweets and/or bakery products.[62,78] In Poland, the most common response was no change in the consumption of sweetened spreads (91.6%), ice cream and pudding (74.9%), and sweetened cereal and/or cereal bars (88.3%).[62] Additionally, one study from Canada found a significant decrease in the consumption of added sugars.[78]

Healthy Eating

A total of 21 studies addressed changes in the healthiness of food eaten during the pandemic.[40,46,53,55,56,62–64,67,68,70,72,74,85,89–95] See Table 8 for a summary of measures and findings.

Seventeen studies used self-report measures to gauge perceived changes in healthy eating (e.g., before and during the pandemic "How would you rate your overall habits of eating healthy foods?").[40,46,55,56,63,64,67,68,70,72,74,89–93,95] The most common finding was no change in the healthiness of foods eaten. [46,55,56,63,67,90,92,95] When the second most common responses are considered for studies that had predominately no-change responses, results are almost equally mixed between increases and decreases in healthy eating. One study out of Qatar found large numbers of participants reported improved healthiness of their diets with 44.5% of respondents perceiving a decrease in unhealthy food consumption and 32.3% perceiving an increase in healthy consumption.[63] Concordantly, studies from Italy[46] and France[95] found the second most common response behind no change (47% and 54% respectively) was improved diet quality (34%)[46] and a more balanced diet (29%).[95] However, the second most common response in a study from Italy was a worsening in eating habits (37.2%)[67] and one large international study found more participants reported eating less healthfully (35.6%) than more healthfully (20.7%).[68]

When the most common response was a change in self-reported perceptions of healthy eating (meaning more respondents indicated there was a change in the healthiness of their meals than not) changes were divided between increases and decreases in healthy eating. For example, one study from Saudi Arabia found that there was a significant increase in participants rating their food as good/excellent in healthiness (22.3% before to 29.5% during the pandemic).[74] Similarly, a study from Vietnam found that 42.8% of respondents reported eating healthier in 2020 than before the pandemic.[91] Conversely, three studies tended towards decreases in healthiness during the pandemic relative to before; one international study with respondents from North Africa, Western Asia, Europe, and 3% "other" countries (not specified by the authors) found that there was a significant increase in participants reporting unhealthy eating from before

561 to during the pandemic.[64] A study from Scotland showed 40.9% of respondents reported their
562 diet was less healthy in 2020 than it was pre-pandemic[92] and 61.2% of participants from a US
563 study reported greater challenge in adhering to healthy diet plans during the pandemic relative to
564 before.[89] Finally, 55% of a sample from Kenya and Uganda reported they were unable to eat
565 healthy/nutritious foods during the pandemic, compared to 21% before.[40] Findings from the
566 study suggests this limitation was related to participants experiencing higher levels food
567 insecurity during the pandemic.

568 Emblematic of these mixed results, studies from the UK[70] and US[93] found close to equal
569 proportions of self-reported diet change. In the US, 37% reported no change in overall diet, 32%
570 reported a healthier diet, and 31% reported a worse diet compared to before the pandemic.[93] In
571 the UK, 31% of participants stated there was no change in how often they ate healthy and
572 balanced meals while 35% reported eating healthier meals more frequently and 35% reported
573 less.[70]

574 Six studies used self-report plus researcher categorization of healthiness to assess
575 changes during the COVID-19 pandemic (e.g., participants would report their consumption of
576 various categories of foods - fish, vegetables, etc. - and the researchers would use these self-
577 report data to code the extent to which the participant followed the Mediterranean diet) with
578 findings showing mixed results.[53,62,67,68,85,94] For example, one study in Italy found that 37.4%
579 reported eating more foods deemed to be healthy defined here by their adherence to the
580 Mediterranean diet (e.g., fruits, nuts, etc.) and 35.8% ate healthy foods less.[67] Moreover, one
581 study in Poland generated three eating patterns based on consumption of healthy foods (e.g.,
582 vegetables) and non-recommended foods (e.g., sweets). The “constant” pattern of relatively
583 stable eating from before to during the pandemic included the largest portion of participants

(53%), followed by the "pro-healthy" pattern of eating (27.6%) characterized by increased intake of healthy foods and decreased intake of non-recommended foods.[62] Three studies used validated measures of healthiness and found opposing results; a study from the US, UK, Australia, Canada and a small portion of other countries found a significant increase in overall healthy eating ($p<.001$),[68] whereas studies from France and Vietnam showed a significant decrease in healthy eating compared to before lockdown ($p<.001$).[53,94] Lastly, one Spanish study measured healthy eating as high adherence to the Mediterranean diet, finding that there was an increase from 4.7% to 8% adherence from before to during the pandemic.[85]

Eating Behaviors Not Otherwise Specified

This section reviews 19 articles addressing changes in four categories of key eating behaviors during COVID-19 compared to before: 1) binge eating,[96–99] 2) uncontrolled/out of control eating,[64,100–102] 3) overeating,[70,93] and 4) restrictive eating behaviors including meal skipping and fasting.[40,65–67,69,70,89,93,97,98,100,102–105] See Table 9 for a summary of measures and findings.

Binge Eating, Uncontrolled Eating, and Overeating

Taken together, binge eating, uncontrolled/out-of-control eating, and overeating represent a similar set of disordered eating behaviors. Studying these behaviors in isolation can be hard for researchers as measures are not always consistent across studies. For example, in this review some studies measuring binge eating used full validated measures,[97,98]a selected portion of a questionnaire on eating patterns.[99] and researcher-derived items such as "compared with before the COVID-19 virus crisis, I have binged on food."[96] These differences not only provide a challenge to generalize across studies but also make it hard to differentiate between these related constructs. For instance, one study used the following two items to measure binge eating: "In the

past month, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you (binge-eating)?" and "During the times when you ate this way, did you feel you couldn't stop eating or control what or how much you were eating?"[99] These items have strong conceptual overlap with out-of-control eating and overeating which are themselves components of binge eating.

In the current review, we will be discussing the three constructs of binge eating, out-of-control eating, and overeating as described in the original studies. Details about each measure and their corresponding results can be found on Table 9.

Binge Eating. Binge eating is defined as eating a large amount of food in a short period of time while feeling an inability to stop eating.[106] Four articles specifically discussed binge eating and found that it generally increased or remained the same during the pandemic.[96–99] For example, in a study from the UK, 49% of participants reported increases in binge eating compared to before the COVID-19 crisis (19% reported less and 33% reported no change).[96] A large proportion of participants (34.6%) in a study from Australia also reported increased binge eating behaviors during relative to before COVID-19 (60% reported no change).[98]

Changes in binge eating were related to several factors. For instance, a longitudinal study from the US found that binge eating was 2.88 times higher during the pandemic among individuals who experienced pre-pandemic weight stigma.[99] Additionally, in one study from France, increases in binge eating at the start of the pandemic were higher among those who had higher BMI, perceived stress, stress related to lockdown, depression, and anxiety, as well as those who were women and had probable eating disorders.[97] Moreover, anticipated bingeing in the next two weeks during lockdown was associated with higher age, depression, stress related to

lockdown, COVID-19 media exposure, and risk of eating disorders and lower BMI, impulse regulation, and body satisfaction.[97]

Uncontrolled/Out of Control Eating. Uncontrolled eating can be described as the inability to control the amount or type of eating once started, regardless of how much was eaten.[106] A total of four articles included uncontrolled eating as a reported measure of eating behavior change during the pandemic.[64,100–102] Overall, there were increases in uncontrolled eating. For example, in one study from North Africa, Western Asia, and Europe, there were more participants reporting eating out of control most of the time (20.4%) and always (9.6%) compared to before the pandemic (9.7% and 2.3% respectively).[64] Similarly, two studies from Turkey found increases in uncontrolled eating behavior compared to before COVID-19;[100,102] one reported that increased uncontrolled eating was related to lower income (compared to higher income) and younger age (18-20 years old compared to above 35).[100] Lastly, the majority of participants in a study from the UK reported either agreeing (29.4%) or strongly agreeing (23.7%) that it was more difficult to control or regulate their eating during the pandemic than it had been before the pandemic.[101]

Overeating. Two articles discussed overeating.[70,93] One study from the UK found increases in overeating during lockdown compared to before, with increases related to being female, being younger, and a lower education, as well as a higher BMI, having had COVID-19, and having negative mental health since lockdown or a previous psychiatric diagnosis.[70] Additionally, a study from the US found equal proportions of respondents reporting more (39%) and no change (39%) in overeating during the pandemic compared to before the pandemic.[93]

Restrictive Eating

Six studies assessed changes in restrictive eating (outside of meal skipping) during the COVID-19 pandemic with mixed results.[93,97,98,100,102,104] Two studies from Australia and the US found that the majority of participants (59% and 52% respectively) reported no changes in food restriction and restricted eating; however, the next largest portion of participants reported an increase (27.6%) of food restriction in the study from Australia[98] and a decrease (28%) of restricted eating in the study from the US.[93] In one study from Turkey, cognitive restraint decreased during the pandemic,[100] and in another study, 9.1% of adults from Turkey reported increased restrained eating during the pandemic.[102]

Varying results in restrictive eating could be related to individual differences. One study from France looked at factors related to changes dietary restriction and found anticipated dietary restriction was higher among women, those whose BMIs were classified as "underweight" or "obese," as well as those who had higher stress related to lockdown, were at risk of eating disorders, had higher levels of body dissatisfaction, lower impulse regulation and higher endorsements of appearance ideals.[97] Similarly, a study of Lebanese adults showed that higher restraint scores were predicted by greater fears related to COVID-19, higher BMI, and more physical activity.[104]

Meal Skipping and Fasting. Ten studies assessed meal skipping and fasting during the pandemic generally finding either no change or a decrease during the pandemic compared to before.[40,65–67,69,70,89,93,103,105] For example, studies from the US and UK showed predominantly no change (both 45%) or a decrease (30-31%) in meal skipping.[70,93] In the same US based study, the majority of individuals (54%) reported no changes in fasting, with 30% of participants reporting less fasting.[93] Still, two studies from the UAE and MENA showed a significant decrease in meal

675 skipping comparing levels before the pandemic (64.4%-65.5%) and during the pandemic
676 (45.1%-46.2%).[65,66] One study out of Kenya and Uganda did find that significantly more
677 individuals skipped meals during the COVID-19 period compared to before.[40] However, there
678 was a significant increase in food insecurity in this sample; skipping meals likely came out of
679 necessity which might be one possible explanation for the disparate findings.[40]

680 There were differences in skipping depending on the meal. For example, one study from
681 Kuwait found there was a decrease in the amount of people skipping the snack between breakfast
682 and lunch and an increase in skipping lunch.[69] Similarly, during the pandemic, participants from
683 Turkey reported skipping breakfast and snacks less and skipping lunch more compared to before
684 the pandemic.[105] Finally, while 17.5% of people in a study from Italy reported skipping meals
685 they normally ate, 23.5% reported they introduced a snack/meal.[67]

686 People cited different reasons for meal skipping. In a US study, parents with financial
687 concerns also reported cutting or skipping meals on more days per month during the pandemic
688 (11.0 ±7.5 days/month) compared to before the pandemic (2.9 ±2.2 days/month).[103] Another US
689 study also found that reports of meal skipping were related to financial strain (12.1% of
690 participants), but overall, the majority (78.3%) of the sample was not food insecure.[89] Finally,
691 studies from the UAE and MENA found that reasons for skipping meals changed with fewer
692 people reporting skipping meals due to lack of time and more in people citing: aims to lose
693 weight (18.5% up to 23.6%), fasting (10.3% up to 25.7%), lack of appetite (27.7% up to 36.0%),
694 and to reduce food intake (21.7% up to 29.1%).[65,66]

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Reasons for Eating

This section reviews changes in reasons for eating reported during the COVID-19 pandemic relative to before the pandemic from a total of 27 articles.[40,45,47,53,55,56,59,65,66,69,70,83,89,93,95,97,99–105,107–110]

One's reasons for changes in eating behaviors can be related to psychological, social, and emotional states,[111,112] all of which have been altered during the COVID-19 pandemic.[17] In the studies reviewed here, three general themes encompass participants' reasons for changes in eating behavior: 1) emotions and mood, 2) cravings, weight control or body image, and 3) increased/decreased environmental opportunity. See Table 10 for a summary of measures and findings.

Emotions and Mood

In general, cross-sectional[45,70,100,107] and longitudinal[102] studies showed increases in emotional eating which were usually related to increased eating. For example, a study from the UK found greater emotional overeating and lower emotional undereating behaviors were associated with increased eating overall.[45] However, emotional eating did not look the same for all respondents; for example, in one study from the UK, 42% of individuals ate more and 26% ate less due to their feelings.[70]

Considering general mood, 48% of participants from a study in France reported mood was of increased importance to their eating behaviors and this increased importance was associated with negative diet quality.[53]

The following subsections discuss specific mood and emotion-related reasons for changes in eating.

Depression and anxiety. Ten studies conducted out of France (3),[95,97,109] Turkey (1),[105] Lebanon (1),[104] the US (1),[99] the UK (1),[101] and Italy (3)[55,59,107] found that depression and anxiety (and related factors) were related to changes in eating behaviors during the early COVID-19 pandemic. For example, 34.7% of participants from a study based out of Italy reported that anxiety and depression were the main reasons for changes in their eating habits.[55]

Depression was investigated less than anxiety, however findings suggest that increased depression and similar forms of negative mental health were related to specific changes in eating behaviors. A study conducted in France reported that negative changes in depression were associated with negative changes in nutrition.[95] Further, a longitudinal study from the US found that experiences of weight stigma and weight-related teasing before the pandemic were related to greater depression scores and eating as a coping mechanism during the pandemic.[99] Two studies reported on factors related to depression. One study out of France found that those who reported increased consumption of higher caloric and salty foods had a higher likelihood of lower mental well-being.[109] Additionally, one study from the UK found that psychological distress was associated with difficulties in eating regulation and control.[101]

Anxiety was highly related to several different changes in eating behaviors. For example, one study from France found that higher anxiety was related to higher rates of both restriction and binge eating.[97] In a study from Lebanon greater anxiety was associated with higher participant eating concerns.[104] Additionally, one study from Turkey found that higher anxiety was associated with increased consumption of certain types of food (e.g., milk, cheese, meat, bread).[105]

In some cases, eating was the source of anxiety, and in others, food was used to quell anxiety. For example, one study conducted in Italy found 57.8% of their participants reported

feeling anxious about their eating habits.[107] In the same study participants reported eating as a response to anxious feelings (48.7%), eating more to feel better (55.1%), and excluding certain foods that specifically led to anxiety (20.3%).[107] In a similar study from Italy, 42.7% of participants reported that of stress, anxiety, and boredom during quarantine were main reasons for their diet and that they ate more "comfort food" as a response to the anxiety.[59]

Stress. Eleven studies representing the US (4),[89,93,99,110] France (3),[95,97,109] Kuwait (1),[69] Poland (1),[108] and the Netherlands (1)[56] investigated stress and found increases in stress eating[89,110] feelings of stress managed by eating,[56,99] the percentage of participants reporting eating in response to stress,[69] and specific eating behaviors (e.g., binging, restricted eating) related to stress.[93,97] For example, 42.7% of participants in a study from Italy reported that increased stress, anxiety, and boredom, was a main reason for their changes in diet over quarantine.[59]

Two studies from the US found increases in the frequency of stress eating and [89] the amount of food eaten in response to stress.[110] In fact, there were many dietary changes in response to stress. Two studies from France found that stress was related to increased consumption of high calorie and salty food[109] and negative changes in diet nutrition.[95] Moreover, 19.2% of participants from a study from the Netherlands reported more stress was an important reason for eating unhealthier during the lockdown.[56]

Stress is also related to maladaptive eating behaviors. For example, in the US higher stress was related to changes in fasting, restricted eating, skipping meals, and overeating [93] Moreover, a study from France found that participants with higher perceived stress and higher stress related to the COVID-19 lockdown had higher instances of binge eating.[97] Higher stress was related to the lockdown was also related to food restriction.[97]

Fear and anger. Studies from Lebanon,[104] Turkey,[105] Poland,[108] and Kuwait[69] found that fear of COVID-19 and anger were reasons for eating changes during the pandemic.[69,104,105,108] Specifically, in a study out of Lebanon, fear of COVID-19 was related to higher scores in restrained eating, and anger and fear of COVID-19 were associated with higher eating concern scores.[104] In a study from Turkey, fear of COVID-19 was associated with increased eating of specific foods such as cakes, cookies, cheese, and dried fruit.[105] One study out of Poland explained that fear of limited access to food (reported by 39% of participants) was most strongly predicted by perceived changes in food availability.[108] Finally, in a study out of Kuwait, a greater number of people who reported eating when they felt angry, stressed, unhappy, or bored was larger during the pandemic compared to before.[69]

Boredom. Five studies found boredom to be a strong influence on eating behaviors during the COVID-19 pandemic.[55,56,69,104,110] For example, one study from Italy found that boredom was a main reason for changes in eating behaviors[55] and in another study from the US, 73% of adults reported eating more when bored.[110] Studies from the Netherlands[56] and Lebanon[104] found that boredom was linked to increased eating concern[104] and was a reason for increased eating during lockdown compared to before.[56]

Cravings

Three studies found that cravings increased or remained the same during the pandemic.[45,101,110] A study based in the UK found 46% of participants reported an increase in cravings during (vs. before) the pandemic with only 23% reporting a decrease.[45] Craving intensity was examined in the same study although 41% reported no changes in craving intensity, the next largest group (36%) reported increased intensity of cravings. Moreover, a higher number of people reported lower craving control during COVID-19 compared to before.[45] These results

parallel findings from the US in which 73% of participants reported an increase in "eating because [they] crave certain foods" during the pandemic relative to before.[110] Relatedly, in one study from the UK, most participants reported that they were more preoccupied with food and/or eating (37.8% agree, 21.8% strongly agree) during the pandemic compared to before.[101]

Weight Control and Body Image

Four studies found that weight loss intentions, weight control, and body dissatisfaction contributed to changes in eating behaviors.[53,65,66,97] For example, one study conducted in France assessing food choice motives found that higher perceived importance of weight control was related to decreased nutritional quality during the pandemic.[53] Similarly, studies from the UAE and MENA found increases in the amount of people citing weight loss intentions as a main reason for skipping meals (18.5%-20.2% before and 23.6%-23.8% during, respectively).[65,66] Relatedly, a study out of France showed that greater feelings of body dissatisfaction and higher endorsement of ideal body stereotypes were related to both increased dietary restriction and binge eating during the pandemic.[97]

Environmental Factors

Thirteen articles reported on environmental factors as reasons for eating.[40,47,55,56,65,66,70,83,89,103,108–110] The specific social and physical environmental factors assessed are presented below.

Eating with Family & Friends. Four studies found that the presence or absence of family and friends influenced individuals' eating during the pandemic.[55,56,109,110] In a study from Italy, 21.3% of participants reported family presence as impacting their eating behaviors.[55] These findings were consistent with a study out of the US in which 59% of participants reported eating more often with friends and family during quarantine compared to before quarantine.[110]

812 Similarly, on study conducted in France found that increased consumption of high calorie and/or
813 salty food was related to being alone during lockdown and having a partner.[109] Moreover, 17.8%
814 of participants from a study out of the Netherlands reported that fewer social contacts and feeling
815 lonely were important reasons for their eating less healthfully during the lockdown.[56]

816 **Time.** Changes in available time showed mixed impacts on eating behaviors. Increased
817 time for cooking was reported among 32.7% of individuals from Italy, and increased cooking
818 time was cited as one of the main reasons for changes in eating behaviors during the pandemic.[55]
819 One study from the UK found that 88% of participants had time to eat healthy.[70] This parallels
820 find from one study from the Netherlands where participants reported that more time and head
821 space to prepare healthy meals (30.3%) and more time and head space to be conscious about
822 healthy meals (26.3%) were some of the top reasons for eating healthier during lockdown.[56]
823 However, in the same study, more leisure time (31.5%) and more time, head space and
824 opportunity to bake (19.2%) were some of the top factors for eating unhealthier during
825 lockdown.[56] Lastly, those reporting a lack of time as a main reason for meal skipping decreased
826 during the pandemic.[65,66]

827 **Increased Exposure to Food.** Food availability and exposure to food cues were also
828 related to changes in eating behaviors during COVID-19. For example, in an Italian sample,
829 19.3% of participants reported the continuous availability of food as a main reason for eating
830 changes.[55] In a study from the Netherlands, 35.6% of participants endorsed an increase in
831 unhealthy temptations at home as a main reason for less healthful eating during the lockdown;
832 however, this same study also suggested decreased exposures to unhealthy food temptations at
833 work, social events, and dinners were important reasons for eating healthier during the

pandemic.[56] Finally, 65% of participants in a study from the US reported increased eating in response to the sight and smell of food during COVID-19 compared to before.[110]

Lack of Resources: Food Insecurity. Food insecurity and low food availability were further reasons for eating changes during the early months of the COVID-19 pandemic. In Kenya and Uganda, there was a 39% increase in food insecurity (16% increase in severe insecurity), and this was related to increases in worrying about not having enough food, being unable to eat healthy/nutritious foods, eating only a few kinds of foods, skipping meals, eating less food, running out of food, feeling hungry and not eating, and going without eating for a whole day.[40] Finding of food insecurity in the US were mixed; one study reported that food security lowered by 17% and families with low food security increased by 20% during the pandemic.[103] Moreover, this same study explained that increases in skipped meals during the pandemic was related to decreases in available money.[103] However, another study from the US found that 78.3% of the sample was not food insecure.[89] Moreover, one study conducted in Canada showed low reports of food insecurity in the past month (at the time of the study) and low expectations of food insecurity in the six months to come[47] and a study from Iran showed that food insecurity significantly reduced during the pandemic.[83] Lastly, a study from Poland found 87.4% of participants noticed changes in food availability, which was the strongest predictor of fear for limited food access (reported by 39%).[108]

Discussion

The COVID-19 pandemic has caused an unprecedented upheaval in the everyday experiences of individuals around the world. The virus and the widely-mandated lockdowns used to prevent its spread left people with limited access to care and support, caused a host of economic and social stressors, and impacted mental health around the world.[17,113] These

857 combined outcomes as well as the disruptions to daily routines can impact eating behaviors in
858 unexpected ways. It is important to understand how eating behaviors have changed during the
859 pandemic not only because of the well-established links between nutrition and a wide-variety of
860 chronic diseases, but also because of newly-emerging evidence linking diet with COVID-19
861 susceptibility.[30,31]

862 This narrative review sheds light on how key eating behaviors changed globally during
863 the early stages of the COVID-19 pandemic for adults without eating disorders. In general, most
864 studies showed that dietary behaviors were more likely to remain the same during the pandemic
865 than they were to change. However, where behaviors like food intake did change, they tended
866 toward increased consumption. For example, aggregated analysis of total intake showed that
867 44.9% of individuals reported no change in the amount of food consumed during the COVID-19
868 pandemic, and the next most common response (31%) was an increase in consumption.
869 Similarly, frequency of consuming meals and snacks generally remained the same, with the next
870 highest response being an increase in the number of meals and snacks consumed. These results
871 are complicated by the use, in many studies, of simplified measures that assessed only increase,
872 decrease, or no change.

873 Regarding changes to types of foods consumed during the pandemic, intake largely
874 remained the same for most food groups, but trends did vary by food category. For fruits and
875 vegetables, legumes, white breads/pastas, homemade pastries, and snacks (general as well as
876 sweet, savory, and salty), participants reported stable or increased consumption. Decreased
877 consumption was reported for specific vegetables such as dark green leafy vegetables. For dark
878 breads/grains, meats (including red meats and processed meats), seafood/fish, frozen foods, and
879 fast food, participants tended to either report no change or decreased consumption. Many of

these increases and decreases could be at least partly explained by reduced access to restaurants during COVID-related lockdowns.[114] Indeed, increased consumption was found for homemade foods in general (and for specific types of homemade foods measured separately, such as pizza and sweets). However, purchasing and consumption behaviors might have shifted more minutely in certain categories due to perceptions of COVID-19 and transmission. For example, people fearing COVID-19 infection may be less likely to buy fruits and vegetables with porous and/or edible skins but may also be keener to purchase and consume peelable vitamin A-rich fruits.[83] In fact, it should be noted that, as detailed above, many other social, psychological, and environmental factors also impacted dietary behaviors during the pandemic.[40,45,47,53,55,56,59,65,66,69,70,83,89,93,95,97,99–105,107–110] As discussed, location and food security, among other factors, influence the types of foods one is able to obtain. These factors are particularly important to consider in the case of fruits and vegetables and fish/seafood as access can differ considerably by region.

Results concerning changes in healthy eating were decidedly mixed. Most self-reported perceptions of changes showed stable levels of healthy eating; however, when eating behaviors did change or were assessed with researcher-generated measures, a similar number of studies reported increases and decreases in eating healthy during the pandemic compared to before. Differing definitions and perceptions of healthfulness as well as the use of measurements derived from various recommendation standards, often communicated on a country-by-country basis, may explain some of these inconsistencies. Moreover, self-reported responses may be more prone to biases due to social desirability and the desire to showcase a healthy lifestyle.[115–117]

Findings show that binge eating, uncontrolled/out of control eating, and overeating tended to increase during the COVID-19 pandemic compared to before. Mixed findings were

found for restrictive eating. In general, meal skipping and fasting decreased, however this varied by region; some findings indicate increases in meal skipping, often due to financial concerns and food insecurity. Of note, there have been several reviews of disordered eating behaviors published prior to this review that lend more detailed findings and additional context to these types of behaviors.[118–121]

Considering reasons for eating, emotions, and moods such as depression, stress, fear, anger, and boredom were all related to changes in eating behaviors, often being an increase in consumption. Cravings, weight control, and body image were also associated with eating behavior changes. Eating more frequently with family and friends and increased exposure to food cues were both related to an increase in food consumption, whereas food insecurity was typically related to a decrease in food consumption. Increases in available time showed mixed results, as some individuals reported cooking healthier meals more often and skipping meals less often, while others used their leisure time to bake which was one of the top reported factors for eating less healthfully during the pandemic.

The overwhelming majority of the research studies reviewed here show, for most people, eating behaviors did not seem to change a great deal in the early periods of the COVID-19 pandemic. This dietary consistency even in the face of a pandemic could be because eating behaviors are largely based in routines and other automatized behaviors.[122] Although daily life changed for many, evidence shows that these habitual behaviors have remained intact.[56]

For those whose eating behaviors did change, they tended to increase in amount and frequency of eating. Similarly, increases were noted for consumption of fruits and vegetables, legumes, white breads/pastas, homemade pastries, and snacks, and for behaviors such as binge eating, uncontrolled eating, overeating and dietary restraint. Notable decreases were found in

amount of food for those who were more food insecure and more generally in the consumption of dark green leafy vegetables, dark breads/grains, meats, seafood/fish, frozen foods, and fast food.

Strengths and Limitations

As of this writing, this is the first comprehensive international narrative review of changes in eating behaviors during the COVID-19 pandemic. This review synthesizes results from 71 articles from over 30 countries worldwide.

The inclusion of data from many countries is a strength of this research but also means that readers must be aware that some data may not represent the patterns of dietary change that may be prevalent in their home regions. For instance, all of the studies that reported on the overall consumption of homemade foods were from countries in the Middle East; this leaves a substantial gap in the current understanding of consumption of homemade foods in other areas of the world. It could be erroneous to assume similar pandemic experiences across different regions and countries; thus, it is important to consider the context of the studies reporting on the various dietary behaviors included in this review when attempting to make inferences about any specific geographic region.

Including only studies published or online-published in 2020 lends some benefits in comparability among the studies published during this timeframe; in general, most studies describe the time period between April and June, 2020. However, this scope provides limited understanding of how eating behaviors progress as pandemic life becomes the "new normal." Future reviews and research studies should seek to longitudinally assess changes in eating behaviors over the course of the pandemic to clarify whether the changes in eating behaviors reported relatively early in the pandemic and reviewed here persist, cease, or otherwise change.

Moreover, the limited scope of this review necessitated the omission of numerous biopsychosocial correlates of eating behaviors that were undoubtedly influential during the pandemic. Previously existing inequities in health and wellbeing were exacerbated by the COVID-19 crisis particularly in areas of food insecurity.[123] For instance, food insecurity during the COVID-19 pandemic may have influenced people to redistribute their food budgets to maximize their purchase in ways they might not have previously done (e.g., calories/cost, storage-ability, etc.) ultimately resulting in an increased or decreased consumption of certain foods.[40,103,124] It is critical to study the intersecting disadvantages faced by individuals who have been socially marginalized, as they are often overlooked in mainstream research despite their relevance to public health policy.[125]

Challenges to Studying Eating During the COVID-19 Pandemic

Disruptions along multiple facets of the research process have generated substantial obstacles for researchers worldwide.[126] Social distancing measures reduced researchers' ability to collect data from participants in person; thus, data collected during the pandemic were largely self-reported. Although some self-report measures are the best options available for assessing specific constructs (such as emotions), other self-report measures can be problematic in terms of accuracy, especially regarding nutrition.[127] Qualitative research during the pandemic faced challenges with interview processes while quantitative researchers, without standardized pandemic-relevant measures, turned to self-generated items leading to a reduced ability to compare findings across studies.[126] Many researchers encountered low response rates to studies even when utilizing more accessible platforms such as online surveys which creates further concerns about sampling bias.[126] Further, there has been a reduction in the timely and expedited approvals from ethics review boards.[128] In addition to logistical obstacles, researchers studying

diet during the pandemic faced hurdles in acquiring the finances and technology needed to run more-involved studies in a timely manner. Lastly, illness or caretaking responsibilities for those who have become ill create extra constraints on researcher time and availability.

The barriers described above are prevalent in the research on eating behaviors, as a paucity of researchers used objective measures in assessing dietary patterns and behaviors. Moreover, truly capturing changes in eating behaviors in an objective way necessitates extant longitudinal designs with comparative data both before and during the pandemic. Only five studies included in this review utilized longitudinal designs.[48,49,88,99,102] Further, conducting controlled experiments assessing the impacts of the COVID-19 pandemic on dietary behaviors was implausible; thus, results from this time period are based in descriptive statistics and cross-sectional associations, and causality should not be inferred.

Implications and Recommendations for Future Research

Scientists have speculated that while it has been over 100 years since the last major pandemic (i.e., the 1918 influenza pandemic), the COVID-19 pandemic will likely not be the only pandemic of the 21st century.[129] Research from the COVID-19 pandemic not only benefits current understanding of the pandemic as it continues to wreak havoc around the globe, but also informs public health professionals about key changes in health behaviors that may be impacting the spread of the virus and the effectiveness of mitigation techniques. Similarly, many lessons can be learned to inform the empirical study of eating behaviors in future public health emergencies.

One of the pressing questions surrounding the COVID-19 pandemic is about the lasting changes it will make to day-to-day life around the globe. Strategically-designed longitudinal studies benefit understanding of dietary changes over time. Given that many of the studies

conducted in 2020 and reviewed here examined earlier timepoints in disease spread and lockdown orders, there exists a dearth of research addressing the long-term effects of the COVID-19 pandemic on eating behaviors around the globe. While this review found that changes in eating behaviors during the pandemic were less prevalent than stable eating patterns, determining how eating changes over the course of the pandemic lends valuable insights regarding altered patterns of behavior during times of crisis, isolation, and daily routine change.

An important area for future research is developing resilience in healthy eating patterns during pandemic conditions. In addition to generalized health benefits, consumption of nutritious foods has been highlighted as an effective tool for personal risk management through bolstered immune system functioning.[30,130] Moreover, further studies should focus on clinical and sub-clinical instances of disordered eating to increase access to care and counseling services as research shows that these populations might be particularly vulnerable to eating behavior disturbances.[131] Lastly, researchers should continue to address how weakness in the economic systems due to public health crises impact food insecurity and corresponding changes in eating behaviors.

Summary

Although the COVID-19 pandemic has been associated with some changes in what and how people eat, by and large, eating behaviors remained quite stable during the COVID-19 pandemic. When changes did occur, there tended to be increases in the amount and frequency of food intake, consumption of food such as snacks and specified behaviors such as binge eating, uncontrolled eating, and overeating. Decreases were found for foods such as fast food and for meal skipping behaviors. Changes in eating behaviors were typically related to changes in mood, emotion, cravings, and/or the environment. Despite the comprehensive nature of this review,

many related biopsychosocial variables are not fully explored. Further work is needed to address the impact of critical factors such as food insecurity. By understanding how health behaviors such as eating change under pandemic conditions, public health officials can develop more targeted campaigns to improve health on a local, national, or international scale.

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Table 1. Study Characteristics and Outcome Variables for 71 Studies Reporting Changes in Eating Behaviors During the Initial Months of the COVID-19 Pandemic

Study characteristics			Change outcome variables						
Citation	**Location, dates, & design**	**Sample characteristics[a]**	**Amount of Food**	**Frequency of eating**	**Timing of eating**	**Types of food eaten**	**Healthy Eating**	**Specified Eating Behaviors**	**Reasons for Eating**
Adams et al., 2020[103]	US April 30–May 23, 2020 Cross-sectional survey	**N**=584 parents **Sex Parents:** 94.5% female, 5.5% male **Sex Children:** 52.1% female, 47.9% male **Mean Age Parents:** 40.4±7.2 years **Mean Age Children:** 9.6±3.8 years **Race and Ethnicity Parents:** 82.7% Caucasian/white, 6% African American, 4.3% Asian, 2.9% American/Indian, 6.5% other, 14.7% Hispanic/Latino **Race and Ethnicity Children:** 82.4% Caucasian/white, 10.1% African American, 5.0% Asian, 3.3% American/Indian, 9.1% other, 19.0% Hispanic/Latino						X	X
Alhusseini & Alqahtani, 2020[74]	Riyadh Saudi Arabia May 5–May 15, 2020 Cross-sectional survey	**N**=2706 **Sex:** 54.2% female, 45.8% male **Age:** 70.2% aged 18-35 years **Race and Ethnicity:** 92.2% Saudi, 7.8% Non-Saudi				X	X		
Aljohani, 2020[41]	Saudi Arabia, Al Madinah city April–June 2020 Cross-sectional survey	**N**= 782 **Gender:** 52.2% females, 47.8% males **Age:** 41.9% aged 31-40 years	X	X					
Almandoz et al., 2020[89]	US, Texas April 15–May 31, 2020	**N**=123 patients with obesity **Sex:** 87% female, 13% male **Mean Age:** 51.2 ± 13 years **Race and Ethnicity:** 49.2% Non-Hispanic white, 28.7% Non-Hispanic Black, 16.4% Hispanic, 5.7% "other" (multiracial, Asian etc)					X	X	X

	Retrospective cross-sectional survey								
Ammar et al., 2020[64]	40% North Africa, 36% Western Asia, 21% Europe, 3% Other April 1– 6, 2020 Cross-sectional survey	**N**=1047 **Gender:** 53.8% female, 46.2% male **Age:** 55.1% aged 18-35 years		X			X	X	
Antunes et al., 2020[42]	Portugal April 1–15, 2020 Cross-sectional survey	**N**=1404 **Sex:** 69.6% female, 30.3% male, 0.1% preferred not to specify **Mean Age:** 36.4 ± 11.7 years	X	X					
Bakhsh et al., 2021[43b]	Saudi Arabia Two weeks between June and early July 2020 Cross-sectional survey	**N**=2255 **Sex:** 64% female, 36% male **Age:** 24% aged 30-39 years **Race and Ethnicity:** 91% Saudi, 9% Non-Saudi	X			X			
Bann et al., 2020[75]	UK May 2020 Cross-sectional survey	**N**=13,283 **Sex:** 49.8% male, 50.2% female **Age:** 19-74 years				X			
Ben Hassen et al., 2020[63]	Qatar May 24–June 14, 2020 Cross-sectional survey	**N**=577 **Gender:** 61.39% female, 38.61% male **Mean Age:** 35.7 years		X		X	X		

Bin Zarah et al., 2020[76]	US April–June 2020 Cross-sectional survey	**N**=3133 **Sex:** 79.4% female, 19.8% male, 0.8% other **Age:** 30.5% aged 30-49 years **Race and Ethnicity:** 5.1% African American, 2.9% Asian, 84.5% white, 2.8% Hispanic, 0.4% Native American, 4.3% other				X			
Błaszczyk-Bębenek et al., 2020[44]	Poland April 29–May 19, 2020 Retrospective cross-sectional survey	**N**=312 **Gender:** 64.1% female, 35.9% male **Mean Age:** 41.1 ± 13.1 years	X	X		X			
Buckland et al., 2021[45]	Predominantly (82.5%) from UK May 15–June 27, 2020 Cross-sectional survey	**N**=588 **Sex:** 69% females, 30% male, 1% non-conforming **Mean Age:** 33.4 ± 12.6 years **Race and Ethnicity:** 86% White, 7% Asian or Asian British, 3% mixed or multiple ethnic groups, 1% Black, African, Caribbean, or Black British, 1% prefer not to say, and 2% other	X			X			X
Cancello et al., 2020[46]	Northern Italy April 15–May 4, 2020 Cross-sectional survey	**N**=490 **Sex:** 83.67% female, 16.33% male **Age:** 65.1% aged 31-60 years	X				X		
Carroll et al., 2020[47]	Canada April 20–May 15, 2020 Cross-sectional survey	**Mothers:** **N**=235 **Mean Age:** 37.5 years **Race and Ethnicity:** 86.8% Caucasian, 0.9% African American, 3.0% Latin American, 4.7% Asian, 3.0% South/West Asian, 1.3% Other **Fathers:** **N**=126 **Mean Age:** 39.4years **Race and Ethnicity:** 88.1% Caucasian, 0.0% African American, 2.4% Latin American, 4.0% Asian, 3.2% South/West Asian, 0.8% Other **Children:** **N**=310 **Mean Age:** 5.7 years	X			X			X

	Nigeria, Turkey, US, Europe April 25–May 5, 2020	**N**=411 **Gender:** 16.3% women, 73.7% men **Age:** 20-65 years				X			
Celik & Dane, 2020[77]	Cross-sectional survey								
	United Arab Emirates (UAE) April – May 2020	**N**=1012 **Gender:** 75.9% female, 24.1% male **Age:** 29.1% aged 26-35 years		X		X		X	X
Cheikh Ismail et al., 2020[66]	Cross-sectional survey								
	Greater Middle East region (and Northern Africa), April 15–April 29, 2020	**N=** 2970 **Sex:** 71.6% female, 28.4% male **Age:** 29.6% aged 18-25 years		X		X		X	X
Cheikh Ismail et al., 2021[65]	Cross-sectional survey								
	US; Detroit, MI and Phoenix, AZ May 13–30, 2020	**N**=861 **Gender:** 53% female, 46% male, 1% nonbinary **Mean Age:** 53 years **Race and Ethnicity:** 80.3% White, 11.3% Black	X			X			
Chenarides et al., 2021[13]	Cross-sectional survey								
	Italy April 24–May 18, 2020	**N**=602 **Gender:** 79.7% female **Mean Age:** 38.2 years							X
Di Renzo, Gualtieri, Cinelli, et al., 2020[107]									

	Cross-sectional survey									
Di Renzo, Gualtieri, Pivari, et al., 2020[67]	Italy April 5–24, 2020 Cross-sectional survey	**N** = 3533 **Gender**: 76.1% female, 23.9% male **Mean Age:** 40.0 ± 13.5 years		X		X	X	X		
Do et al., 2020[90]	Vietnam April 6–19, 2020 Cross-sectional survey	**N**= 5209 health care workers **Gender:** 67.1% women, 32.9% men **Age:** 82.6% aged 21-40 years					X			
Duong et al., 2020[91]	Vietnam April 7–May 31, 2020 Cross-sectional survey	**N**=7616 nursing and medical students **Gender:** 62.5% women, 37.5% men **Mean Age:** 21.4 ± 1.8 years					X			
Elmacloğlu et al., 2021[102]	Turkey May 6–26, 2020 Longitudinal	**N**=1036 **Gender:** 79.8% female, 20.2% male **Mean Age:** 33.1 years						X	X	
Flanagan et al., 2021[68]	US (n=4,890), United Kingdom (n=1,839), Australia (n=497), Canada (n=154), Other (n=373) April 3–May 3, 2020 Cross-sectional survey	**N**=7753 **Sex:** 80% female, 20% male **Mean Age:** 51.2 ± 0.2 years **Race and Ethnicity:** 89.6% white		X		X	X			

	France March 26–27, 2020 Cross-sectional survey	**N=**5,738 students **Sex:** 74.6% female, 25.4% male **Mean Age:** 21.2 years						X	X
Gallo et al., 2020[48]	Brisbane, Australia May 12–26, 2020 Longitudinal	<u>2020 Females</u>:[c] **N**=84 **Age Range:** 19-26 years **Race and Ethnicity:** 32.1% Asian, 9.5% Asian sub-continental, 52.4% Caucasian, 2.4% Multi, 3.6% other/not disclosed <u>2020 Males:</u> **N**=66 **Age Range:** 19-27 years **Race and Ethnicity:** 37.9% Asian, 9.1% Asian sub-continental, 43.9% Caucasian, 6.1% Multi, 3.0% other/not disclosed <u>2019 Females:</u> **N**=108 **Age Range:** 19-23 years **Race and Ethnicity:** 25.9% Asian, 9.3% Asian sub-continental, 55.6% Caucasian, 5.6% Multi, 3.7% other/not disclosed <u>2019 Males:</u> **N**=77 **Age Range:** 19-25 years **Race and Ethnicity:** 23.4% Asian, 9.1% Asian sub-continental, 54.5% Caucasian, 1.3% Multi, 11.7% other/not disclosed <u>2018 Females:</u> **N**=103 **Age Range:** 19-26 years **Race and Ethnicity:** 28.2% Asian, 2.9% Asian sub-continental, 63.1% Caucasian, 2.9% Multi, 2.9% other/not disclosed <u>2018 Males:</u> **N**=71 **Age range:** 19-25 years **Race and Ethnicity:** 32.4% Asian, 5.6% Asian sub-continental, 54.9% Caucasian, 2.8% Multi, 4.2% other/not disclosed	X	X		X			
Giacalone et al., 2020[61]	Denmark April 24–May 5, 2020 Cross-sectional survey	**N**=2462 **Gender:** 71.1% women, 28.7% men, 0.2% other **Age:** 37.2% aged 36-50 years	X	X		X			

Górnick et al., 2020[62]	Poland April 30–May 23, 2020 Cross-sectional survey	**N=**2,381 **Sex:** 89.8% female, 10.2% male **Age**: 44.8% aged 30-39 years	X			X	X		
Haddad et al., 2020[104]	Lebanon April 3–18, 2020 Cross-sectional survey	**N=**407 **Gender:** 51.3% female, 48.7% male **Mean Age:** 30.6 ± 10.1 years						X	X
Herle et al., 2021[49]	UK March 28–May 29, 2020 Longitudinal	**N=** 22,374 **Gender:** 76% women, 24% men **Age:** 32% aged 46-59 years **Race and Ethnicity:** 5% Black, Asian, and minority ethnicity, ref white ethnicity	X						
Huber et al., 2021[50]	German federal state Bavaria Two weeks in March and April 2020 Cross-sectional survey	**N=** 1,957 students **Sex:** 71.5% female, 28.5% male **Mean Age:** 23.3±4.0 years	X			X			
Husain & Ashkanani, 2020[69]	Kuwait March 30–April 15, 2020 Cross-sectional survey	**N=**415 **Gender:** 68.7% female, 31.3% male **Mean Age:** 38.5 ± 12.7 years		X		X		X	X
Ingram et al., 2020[92]	Scotland 5 weeks during COVID-19 restrictions	**N=**399 **Gender-Sex:** 56.4% female, 41.9% male, 1% non-binary, 0.8% trans **Mean Age:** 32.4 ± 11.4 years					X		

	in Scotland Cross-sectional survey[d]								
Jeżewska-Zychowicz et al., 2020[108]	Poland March 19–24, 2020 Cross-sectional survey	**N**=1033 **Gender:** 50.2% female, 49.8% male **Mean Age:** 39.9 ± 13.1 years							X
Kansiime et al., 2021[40]	Kenya and Uganda April 18–27, 2020 Cross-sectional survey	Kenya: **N**=313 **Gender:** 61% female **Age:** 63% youth (18-35 years), 37% "adult" Uganda: **N**=129 **Gender:** 63% female **Age:** 38% youth (18-35 years), 62% "adult"	X			X	X	X	X
Kaya et al., 2021[105]	Turkey April 15–30, 2020 Cross-sectional survey	**N**=1012 **Gender:** 81.7% female, 18.3% male **Mean Age:** 28.3 ± 8.7 years						X	X
Khubchandani et al., 2020[93]	US Last week of April 2020 Cross-sectional survey	**N**= 838 **Sex:** 52% female, 48% male **Age:** 34.4 ± 0.4 years **Race:** 63% White, 23% Asian, 7% Black, 5% Multiracial, 3% other **Ethnicity:** 22% Hispanic, 78% Non-Hispanic					X	X	X
Kriaucionienė et al., 2020[51]	Lithuania April 14–28, 2020 Cross-sectional survey	**N**= 2447 **Sex:** 87.8% female, 12.2% male **Age:** 40.1% aged 18-35 years	X			X			
Lamarche et al., 2021[78]	Canada, Quebec April 15–May 12, 2020	**N**= 853 **Sex:** 87.2% female, 12.8% male **Age:** 52.5% aged 50-69 years				X			

	Cross-sectional survey								
	Spain March 22–April 5, 2020	**N**=2,741 **Gender:** 51.8% women, 48.2% men **Mean Age:** 34.2 ± 13.0 years				X			
López-Bueno et al., 2020[79]	Cross-sectional survey								
	Spain May 28–June 21, 2020	**N**=675 **Gender:** 69.9% women, 30.1% men **Mean Age:** 39.1 ± 12.9 years	X	X					
López-Moreno et al., 2020[52]	Cross-sectional survey								
	Brazil April 24–May 24, 2020	**N**= 45,161 **Sex:** 53.6% female, 46.4% male **Age:** 24.7% aged 18-29 years				X			
Malta et al., 2020[80]	Cross-sectional survey								
	France April 30–May 1, 2020	**N**=938 **Gender:** 78.5% female, 21.5% male **Mean Age:** 38.7 ± 11.6 years	X				X		X
Marty et al., 2021[53]	Cross-sectional survey								
	Zimbabwe May 11–25, 2020	**N**=507 **Gender:** 63.0% female, 37.0% male **Age:** 48.1% aged 31-40 years				X			
Matsungo & Chopera, 2020[81]	Cross-sectional survey								
	Island of Ireland, Great Britain, United States, and New Zealand	Island of Ireland: **N**=538 **Gender:** 87.5% female, 12.5% male **Mean Age:** 35.9 ± 12.5 years Great Britain: **N**=961 **Gender:** 51.0% female, 48.7% male, 0.3% other				X			
Murphy et al., 2021[82]									

		Mean Age: 50.7 ± 15.3 years							
	May– June 2020	United States:							
		N=381							
	Cross-sectional survey	**Gender:** 53.4% female, 46.1% male, 0.5% other							
		Mean Age: 53.7 ± 18.4 years							
		New Zealand:							
		N=480							
		Gender: 51.9% female, 47.7% male, 0.4% other							
		Mean Age: 45.7 ± 17.2 years							
Pakravan-Charvadeh et al., 2021[83]	Iran, Tehran province March 2020 Cross-sectional survey using both retrospective and current reporting	**N**= 292 families **Mean Age:** 47.5 ± 13.5 years				X			X
Papandreou et al., 2020[54]	Spain and Greece April 23–May 3, 2020 Cross-sectional survey	**N**= 1841 Spain: **N**=1,002 **Sex:** 70.3% women **Mean Age** = 46.1 ± 13.3 years Greece: **N**=839 **Sex:** 66.7% women **Mean Age** = 42.4 ± 11.7 years	X	X	X	X			
Pellegrini et al., 2020[55]	Italy April 14–21, 2020 Retrospective cross-sectional survey	**N**=150 **Gender:** 77.3% female, 22.7% male **Mean Age:** 47.9 years	X	X		X	X		X
Pham et al., 2020[94]	Vietnam February 14– May 31, 2020 Cross-sectional survey	**N**= 8,291 **Gender:** 53% women, 41% men **Age:** 43.6 ± 16.9 years					X		

	Australia April 1– 4, 2020 Cross-sectional survey	**N=**5,289 **Sex:** 80.0% female, 17.9% male, 2.1% preferred to self-describe or did not answer **Mean Age:** 40.6 years						X		
Phillipou et al., 2020[98]										
	Netherlands April 22–May 5, 2020 Cross-sectional survey	**N=** 1030 **Gender:** 50.5% female, 49,5% male **Mean Age:** 49.9 (SD 17.0) years	X	X	X		X			X
Poelman et al., 2021[56]										
	US (90% from Minnesota) April–June 2020 Longitudinal	**N=** 584 **Gender:** 64.2% female, 34.4% male, 1.4% another gender identity **Mean Age:** 24.6 ± 2.0 years **Race and Ethnicity:** 30.2% white, 16.8% African American/Black, 17.1% Hispanic, 24.3% Asian American, 11.6% other						X		X
Puhl et al., 2020[99]										
	UAE May 5–18, 2020 Cross-sectional survey	**N=** 2,060 **Gender:** 75.1% female, 24.9% male **Age:** 31.7% between 18 and 30 years, 38.4% between 31 and 40 years, and 29.9% older than 40 years	X				X			
Radwan et al., 2020[57]										
	Chile 8 weeks of May–June, 2020 Cross-sectional survey	**N=** 700 **Sex:** 75.4% women, 24.6% men **Median Age:** 31 years	X				X			
Reyes-Olavarría et al., 2020[58]										
	UK May 11–June 26, 2020 Cross-sectional survey	**N=**264 **Gender:** 78% women **Age:** 42% aged 18–29 years, and 58% aged 30+ years **Race and Ethnicity:** 92% white						X		X
Robertson et al., 2021[101]										

Robinson et al., 2021[70]	UK April 28–May 22, 2020 Cross-sectional	**N=** 2002 **Gender:** 61.7% female, 37.8% male, .5% prefer not to say or non-binary gender **Age:** 34.7 (SD 12.3) years **Race and Ethnicity:** 89.7% white		X			X	X	X
Robinson et al., 2020[96]	UK April 19–22, 2020 Cross-sectional survey	**N=** 723 **Gender:** 67% female **Mean Age:** 30.7 (SD 9.6) years **Race and Ethnicity:** 80% white, 20% non-white						X	
Rodríguez-Pérez et al., 2020[84]	Spain March 20–April 10, 2020[e] Cross-sectional survey	**N=** 7514 **Gender:** 71% female, 29.3% male, .07% other gender **Age:** 92% aged 31–65 years				X			
Rolland et al., 2020[109]	France March 25–30, 2020 Cross-sectional survey	**N=** 11,391 **Gender:** 52.1% female, 47.5% male, 0.4% other **Mean Age:** 47.5 (SD 17.3) years							X
Rossinot et al., 2020[95]	France April 23–May 7, 2020 Cross-sectional survey	**N=** 1454 **Gender:** 63.5% female, 36.0% male, 0.5% other **Age:** 27.0% aged 25-34 years, 29.4% aged 35-44 years, 28.2% aged 45-54 years, 15.5% aged 55-64 years					X		X
Sánchez-Sánchez et al., 2020[85]	Spain May 2020 Cross-sectional survey	**N=** 385 **Gender:** 72.8% female, 27.2% male **Age:** 38.7 (SD = 12.4) years				X	X		
Scarmozzino & Visioli, 2020[59]	Italy April 3–15, 2020	**N=** 1,929 **Sex:** 67% female, 32.9% male, 0.1% not answered **Age[f]:** 63.1% aged 21-35 years, 9.6% aged 36-50 years, 11.4% aged 51-65 years, 14.4% < 20 years, 1.5% > 65 years	X			X			X

	Cross-sectional survey								
	US; Houston, Dallas, Washington, DC, and Southwest Florida April 2020	**N**=1,048 **Sex:** 97.0% female, 3% male **Mean Age:** 36.7 ± 7.3 years **Race and Ethnicity:** 7.1% Black or African American, 85.9% Mexican American, Latino, or Hispanic, 3.7% Non-Hispanic White, 3.4% other				X			
S. V Sharma et al., 2020[86]	Cross-sectional survey								
	Poland April 17–May 1, 2020	**N**=1097 **Gender:** 95.1% female, 4.9% male **Mean Age:** 27.7 ± 9.0 years	X	X					
Sidor & Rzymski, 2020[60]	Cross-sectional survey								
	Turkey May 18–31, 2020	**N**= 397 **Gender:** 39.8% female, 60.2% male **Age:** 40.3% aged 36-50 years						X	X
Şimsek & Şen, 2020[100]	Cross-sectional survey								
	India April– July 2020	**N**=422 **Sex:** 56.4% female, 43.6% males **Age:** 83.9% aged 20-50 years			X				
Sutaria et al., 2020[73]	Cross-sectional survey								
	China March 23–April 26, 2020	**N**=2,289 **Sex:** 48.6% female, 51.4% male **Mean Age:** 27.5 ± 12.0 years		X			X		
Wang et al., 2020[72]	Cross-sectional survey								
Werneck et al., 2020[87]	Brazil	Without Depression: **N**=35,042 **Sex:** 50.8% women, 49.2% men **Age:** 48.2% aged 18-39				X			

	April 24–May 24, 2020 Retrospective Cross-sectional survey	With Depression: **N**=6,881 **Sex:** 68.2% women, 31.8% men **Age:** 51.8% aged 18-39 years						
Yılmaz et al., 2020[71]	Turkey April 5–6, 2020 Cross-sectional survey	**N**=866 students **Sex:** 78.2% female, 21.8% male **Mean Age:** 21.2 ± 1.4 years		X		X		
Zeigler et al., 2020[110g]	US Not specified Cross-sectional survey	**N**=173 **Sex:** 55.5% female, 44.5% male **Mean Age:** 28.1 ± 12.5 years **Race and Ethnicity:** 66% White or Caucasian, 23% Hispanic, 4% African American, 4% Asian, 2% Hawaiian						X
Zhang et al., 2020[88]	China March and August 2020 Longitudinal	**N**= 1994 **Gender:** 62.8% female, 37.2% male **Age:** 89% aged 18-45 years, 10.8% aged >45 years				X		

[a] Some studies used terminology regarding sex (female, male) to describe gender. Similarly, some studies used terminology related to gender (women, men) to describe sex. This terminology was not edited in this review; gender and sex statistics are presented as they are described in the original article

[b] References with publication dates of 2021 were made available in the year 2020.

[c] Gallo et al., 2020[48] included three cohorts of Australian university undergraduate students recruited over three different years (2018, 2019, 2020) and compares eating behaviors across men and women separately.

[d] Ingram et al., 2020[92] collected data at three time points described as weeks 1, 3, and 5. However language related to healthy eating refers to levels before and during lockdown. It is assumed the data used is from week 1 and thus this data is being treated as cross-sectional in nature.

[e] Rodríguez-Pérez et al., 2020[84] lists a beginning date, however an end date is not precisely stated. The original reference states "The questionnaire was open from March 20, concretely one week after the Spanish COVID-19 outbreak confinement started. Data from the 3 first weeks of confinement were collected." The current authors have interpreted this as a 3-week long study ending on April 10, 2020.

[f] The original reporting by Scarmozzino & Visioli, 2020[59] did not include an age category that contained age 20.

[g] Study dates for Zeigler et al., 2020[110] are not listed. The manuscript was received on May 12, 2020, and results discuss before and after lockdown, suggesting the study was conducted in the early months of the pandemic.

Table 2. Measures and Findings for the Aggregated Analysis of Amount of Food Eaten from 12 studies During the Initial Months of the COVID-19 Pandemic

Citation	Measure/Items (M/I) & Response Options (RO)	Study *n*	Findings: n (%)
Bakhsh et al., 2021[43]	**M/I:** "Quantity of Consumed Food" **RO:** Decrease/ no change / increased	2,255	NC[a]: 878 (38.9%) I[b]: 894 (39.6%) D[c]:483 (21.4%)
Błaszczyk-Bębenek et al., 2020[44]	**M/I:** "In Your Opinion, Has Your Diet Changed Due to the Social Isolation" **RO:** No, I was eating the same kind and quantity of food/ Yes, I was eating the same products, but in greater quantities/ Yes, I was eating the same products, but in smaller quantities/ Yes, I have changed my product range without changing the quantities/ Yes, I have changed my product range and I eat more/ Yes, I have changed my product range and I eat less	312	NC: 149 (47.8%) I: 102 (32.7%) D: 61 (19.5%)
Buckland et al., 2021[45]	**M/I:** "Has the AMOUNT of food you have eaten changed since the lockdown?" **RO:** Decrease/ no change / increased	559[d]	NC: 141 (25.2%) I: 268 (48.0%) D:150 (26.8%)
Cancello et al., 2020[46]	**M/I:** "Can you quantify how much you are eating during lockdown?" **RO:** More than usual/ less than usual/like before /I don't know	481[e]	NC: 211 (43.9%) I: 206 (42.8%) D: 64 (13.3%)
Górnick et al., 2020[62]	**M/I:** "Has your total food consumption changed since the beginning of the pandemic (compared to the period before the pandemic)?" **RO:** I eat more/I eat the same/I eat less	2,381	NC: 1229 (51.6%) I: 816 (34.3% D: 336 (14.1%)
Huber et al., 2021[50]	**M/I:** "How has your diet changed since implementation of lockdown?—Overall food amount" **RO:** Less/unchanged/more	1,957	NC: 1019 (52.1%) I: 610 (31.2%) D:328 (16.8%)
López-Moreno et al., 2020[52]	**M/I:** "Do you think you are eating more or less than before? **RO:** More/less/same"	675	NC: 318 (47.1%) I: 132 (19.6%) D: 225 (33.3%)
Papandreou et al., 2020[54]	**M/I:** "Has the amount of food increased during [lockdown]" **RO:** Decrease/ same/ increased	Spain: 1,002 Greece:839 Total:1,841	Spain: NC: 143 (14.3%) I: 114 (11.4%) D: 745 (74.3%) Greece: NC: 158 (18.8%) I: 152 (18.1%) D: 529 (63.1%) Total: NC: 301 (16.4%) I: 266 (14.4%) D: 1274 (69.2%)
Pellegrini et al., 2020[55]	**M/I:** "Have you changed eating habits during the lockdown period?" **RO:** No, I have maintained my eating habits/ Not too much, with a few exceptions/ I eat more than before quarantine/ I eat less than before quarantine	150	NC: 71 (47.3%) I: 60 (40%) D: 19 (12.7%)
Poelman et al., 2021[56]	**M/I:** "Did you eat more or less than usual [during lockdown]" **RO:** More/ no difference/ less	1,030	NC: 854 (82.9%) I: 92 (8.9%) D:84 (8.2%)

Radwan et al., 2020[57]	**M/I:** "Amount of food consumed during lockdown" **RO:** Decrease/ same/ increase	2,060	NC: 1061 (51.5%) I: 655 (31.8%) D:344 (16.7%)
Reyes-Olavarría et al., 2020[58]	**M/I:** Perceived amount of food consumed[f] **RO:** Less than before/ same than before/ more than before	700	NC: 237 (51.3%) I: 359 (33.8%) D:104 (14.9%)
Total weighted sample size and results		14,401	NC: 6,469 (44.9%) I: 4,460 (31.0%) D: 3,472 (24.1%)
Total weighted sample size and results without Papandreou et al., 2020[54]		12,560	NC: 6,168 (49.1%) I: 4,194 (33.4%) D: 2,198 (17.5%)

[a] NC represents no change in amount of food consumed

[b] I represents an increase in amount of food consumed

[c] D represents a decrease in amount of food consumed

[d] The *n* reported for Buckland et al., 2021[45] corresponds to the number of participants who answered the item of interest. The total sample size for the overall study was 588 individuals.

[e] In Cancello et al., 2020[46], 2% of the total study sample (490 adults) reported having "no idea" about changes in their food intake. The findings reported for this portion of the review reflect the responses of the participants reporting NC, I, or D. In rounding to establish whole numbers of participants given the percentages available in the original reference, sample sizes for all response options necessitated upward rounding. Thus, the total sample size is inflated to 491 participants with 481 represented in the current findings related to changes in food intake.

[f] Reyes-Olavarría et al., 2020[58] reports the measure variable as "Among of consumption food, perception."

Table 3. Measures and Findings for Changes in the Total Amount of Food (Non-Aggregated Studies) During the Initial Months of the COVID-19 Pandemic

Citation	Measure/Items (M/I) & Response Options (RO)	Findings
Aljohani, 2020[41]	**M/I:** "Has there been an increase in your food intake during the pandemic lockdown?" **RO:** Yes/ No/ Maybe/ Sometimes/ Prefer not to answer	63% Yes 22.1% No 5.75% Maybe 2.56% Sometimes 6.52% Prefer not to answer
Antunes et al., 2020[42]	**M/I:** "Do you feel you eat more than usual?" **RO:** Yes/No	68.4% No 31.6% Yes
Carroll et al., 2020[47]	**M/I:** If responded "yes" to changes in diet, asked in what ways has their diet (or their children's diet) changed. **RO:** Eating more/less food	Most common behavior changes were eating more food (mothers, 57%; fathers, 46%; children, 42%),
Chenarides et al., 2021[13a]	**M/I:** "How much has your diet changed since COVID-19 started?" **RO:** Eat more, eat less, eat about the same, ate less healthy, ate more healthy Could select multiple answers	62.9% same 22.8% more 14.4% less
Gallo et al., 2020[48]	**M/I:** 24 hr recall task (Automated Self-Administered Dietary Assessment Tool (ASA24-Australia-2016) Compared to previous years.	For females, total 24-h energy intake was 19.5% higher in 2020 compared with 2018/2019 ($p<0.01$). No difference in males.
Giacalone et al., 2020[61]	**M/I:** "Do you think that you are eating more than usual during the confinement?" **RO:** Yes/No	57.2% reported Yes 42.8% reported No
Herle et al., 2021[49]	**M/I:** "Over the past week have you eaten[b] more than usual?" (At the very start of lockdown, longitudinally for 8 weeks) **RO:** Less than usual/ about the same/ more than usual	LPA profiles 64%, had no change in eating throughout the observed period 9% reported persistently eating less 16% reported persistently eating more 8% showed an initial increase in reported eating then a steady decrease 4% reported no changes in 1st week and increased consumption over time.
Kansiime et al., 2021[40]	**M/I:** The Food Insecurity Experience Scale (FIES)[132] In FIES: "You ate less than you thought you should?" In study: "Ate less amount of food" RO: Yes/No	Percent of people reporting eating less food during a "normal period" (not COVID-19 period) and during the COVID-19 period. All are significant ($p<.01$) In total sample: 23% normal period, 54% COVID-19 period Kenya sample: 24% normal period, 56% COVID-19 Uganda sample: 19% normal period, 48% COVID-19 period
Kriaucioniene et al., 2020[51]	**M/I:** "Perception of eating more during the quarantine" **RO:** Yes/No	50.6% No 49.4% Yes
Marty et al., 2021[53]	**M/I:** Validated food frequency measure to estimate energy intake.	Average of 1935 kcal/day (SD 656) in 1st month in lockdown compared to 1700 kcal/day (SD 596) in the month before ($p<0.001$).
Scarmozzino & Visioli, 2020[59]	**M/I:** "Would you say that you are eating more during this lockdown?	47.1% No 46.1% Yes, a bit more

	RO: Yes, much more/ Yes, a bit more/No	6.8% Yes, much more
Sidor & Rzymski, 2020[60]	**M/I:** "Did you consume more food than usual during quarantine?" **RO:** Decidedly yes/ yes / hard to decide / no / decidedly no	43.5% reported eating more

[a] Chenarides et al., 2021[13] used an item that allowed participants to select multiple answers, two of which were irrelevant to the current findings (those regarding healthiness). The findings reported here reflect only the responses to the items related to food intake amount which were reported by 808 participants (the total sample was 861). Percentages are equal to 100.1% due to rounding.

[b] The original item reflected in Herle et al., 2021[49] was "Over the past week have you eating more than usual?"

Table 4. Measures and Findings for Changes in the Frequency of Eating During the Initial Months of the COVID-19 Pandemic

Citation	Measure/Items (M/I) & Response Options (RO)	Findings
Aljohani, 2020[41]	**M/I:** "In the occurrence of having an increase in your food intake, how many meals do you consume a day?" **RO:** 4-5 meals/6-7 meals/More than 7 meals **M/I:** "Have you started eating light meals after dinner (during the lockdown period)?" **RO:** Yes/No/Sometimes	63% reported an increase in their food consumption, and of those who increased their food consumption, 75% ate 6 to 7 meals a day, 14.4% ate more than 7 meals a day, and 9.9% ate 4 to 5 meals a day, respectively. Percent reporting light meals after dinner 47.9% started eating during lockdown 41.3% did not start eating during lockdown 10.7% started eating sometimes during lockdown
Ammar et al., 2020[64]	Both measured as before and after lockdown **M/I:** "How likely are you to have a snack between meals or a late-night snack?" **RO:** Never/Sometimes/Most of the time /Always **M/I:** "How many main meals do you eat a day?" **RO:** 1-2/3/4/5/more than 5	Percentage of people reporting having a snack between meals or a late-night snack: Never: 19.77% before; 14.71% during Sometimes: 59.41% before; 45.56% during Most of the time: 13.85% before; 24.36% during Always: 6.97% before; 15.38% during Overall, there was a significant increase in snacking between meals or late-night ($p<.001$). Percentage of respondents reporting eating certain numbers of main meals: 1-2 meals: 35.15% before; 29.99% during 3 meals: 55.11% before; 46.42% during 4 meals: 6.59% before; 14.52% during 5 meals: 2.39% before; 6.30% during More than 5 meals: 0.76% before; 2.77% during There was a significant increase in the number of meals eaten.
Antunes et al., 2020[42]	**M/I:** "Do you feel you eat more often than usual?" **RO:** Yes/No	45.2% reported a higher food frequency 54.8% reported their food frequency was not higher
Ben Hassen et al., 2020[63]	**M/I:** Change of food-related activities during the COVID-19 pandemic. Eating between meals (e.g., snacks). **RO:** Never /First Time /Much Less /Slightly Less /About the Same /Moderately More /Much More	Percent of respondent reporting on snacking between meals: 4.7% reported never snacking 0.50% reported their first time snacking 6.8% reported snacking much less 7.3% reported snacking slightly less 45.5% reported snacking about the same 23.3% reported snacking moderately more 12% reported snacking much more.
Błaszczyk-Bębenek et al., 2020[44]	Survey questions were adapted from the Dietary Habits and Nutrition Beliefs Questionnaire for people aged 15-65 years[133]	Percentage of people reporting eating certain numbers of main meals before and after lockdown:

	M/I: "How many meals do you usually consume daily?" **RO:** 1 meal/day/ 2 meals/day/ 3 meals/day/ 4 meals/day/ 5+ meals/day **M/I:** How often do you snack between the meals? **RO:** Not listed Never/ 1-3 times/month/ Once/week/ Few times/week/ Once/day/ Few times/day	1 meal/day 0.6% before; 0.3% after (0.3% decrease) 2 meals/day 7.1% before; 4.8% after (2.3% decrease) 3 meals/day 32.1% before; 23.1% after (9% decrease) 4 meals/day 40.4% before; 40.7% after (0.3% increase) 5 meals+/day 19.9% before; 31.1% after (11.2% increase) The increase in 5+ meals/day was significant (p<.001) 72.8% before and 77.9% during reported they regularly snacked (few times per week and more), This was a significant increase (p = 0.0001).
Cheikh Ismail et al., 2020[66]	**M/I:** How many meals did you eat per day before coronavirus pandemic? **RO:** 1-2/ 3-4/More than 5 **M/I:** How many meals do you eat per day during coronavirus pandemic? **RO:** 1-2/ 3-4/More than 5	Percentage of respondents reporting eating certain numbers of main meals: 1-2 meals: 46.4% before; 36.5% during 3-4 meals: 51.5% before; 56.5% during 5+ meals: 2.1% before; 7.0% during The increase in 5+ meals/day was significant (p<.001)
Cheikh Ismail et al., 2021[65]	**M/I:** How many meals did you eat per day before coronavirus pandemic? **RO:** 1-2/ 3-4/More than 5 **M/I:** How many meals do you eat per day during coronavirus pandemic? **RO:** 1-2/ 3-4/More than 5	Percentage of respondents reporting eating certain numbers of main meals: 1-2 meals: 45.6% before; 37.5% during 3-4 meals: 52.2% before; 56.2% during 5+ meals 2.2% before; 6.2% during The increase in 5+ meals/day was significant (p<.001)
Di Renzo, Gualtieri, Pivari, et al., 2020[67]	**M/I:** "Did you change the number of daily meals, during this period " **RO:** No, it didn't/Yes, I skip 1 or more of the main meals (breakfast, lunch, dinner)/Yes, I skip 1 or more of snacks between meals/Yes, I added 1 or more of the main meals/Yes, I added 1 or more of the snacks between meals/Yes, I eat out of the meals[a].	57.8% did not change their number of daily meals 17.5% skipped a meal or snack 23.5% introduced a meal or snack
Flanagan et al., 2021[68]	**M/I:** Changes in dietary behaviors were assessed. The form included questions about cooking and eating out habits and snacking prior to and during the pandemic. Perception of overall healthy eating habits and weight change was asked. The optional long form was a modification of the Rapid Eating Assessment (REAP-s).[134]	25.8% reported an increase in healthy snacking 43.5% reported an increase in unhealthy snacking
Gallo et al., 2020[48]	**M/I:** 24 hr recall task (Automated Self-Administered Dietary Assessment Tool (ASA24-Australia-2016) Compared to previous years.	Among males, there was no difference in the number of snack occasions between 2020 and 2018/2019

		In females, there was an increase to two snack occasions in 2020 compared with one in 2018/2019 ($p < 0.05$)
Giacalone et al., 2020[61]	**M/I:** "Have you increased the frequency of snacking during the confinement compared to your usual intake?" **RO:** Yes. My snacking frequency is higher/ No. My snacking frequency is lower /My snacking frequency remains as usual"	41.7% snacked more frequently 47.5% snacked as frequently as usual 10.8% snacked less frequently
Husain & Ashkanani, 2020[69]	**M/I:** How many times a day do you eat? **RO:** One time/Two times/Three times/Four times/ Five times /Six or more	No significant changes in meal frequency. Percentage of respondents reporting eating a certain number of times per day: 1 time/day: 1.2% before; 1.0% during 2 times/day: 13.5% before; 10.4% during 3 times/day: 29.9% before; 27.0% during 4 times/day: 31.6% before; 25.1% during 5 times/day: 19.3% before; 21.4% during 6+ times/day: 4.6% before; 15.2% during
López-Moreno et al., 2020[52]	Asked for before and after lockdown **M/I:** How many intakes do you make per day of these top five? Check the ones you usually do. **RO:** Before/During confinement: Breakfast/Mid-morning/Lunch/Snack/Dinner/Bedtime snack	Before 1% reported eating 5 meals/ day During 23% reported eating 5 meals/ day
Papandreou et al., 2020[54]	**M/I:** The Dutch Eating Behaviour Questionnaire (DEBQ)[135] was utilized to assess eating behaviors.	59.8% of the Spain sample and 51.7% of the Greece sample reported that they follow same hours/number of meals during the pandemic 34.1% of the Spain sample and 40.8% of the Greece sample reported that they did increase the number of snacks between meals during the pandemic
Pellegrini et al., 2020[55]	**M/I:** "During the lockdown period, the number of snacks that you consume in a day": **RO:** I don't consume snacks usually/ Is less than before quarantine/Is the same as before quarantine/ Is more than before quarantine	28% "I don't consume snacks usually" 11.3% "is less than before quarantine" 28% "is the same as before quarantine" 32.7% "is more than before quarantine."
Poelman et al., 2021[56]	**M/I: P**articipants asked to identify if they ate differently than usual (with more awareness, taking more time, during different occasions, more often and snacking more frequently). **RO:** Fully disagree (1) to fully agree (5). Calculated the number of participants that (fully) agreed on each of the items (score 4 or 5).	14.2% ate more frequently 22.1% reported eating more sweets and snacks
Robinson et al., 2021[70]	**M/I:** "Compared to before the COVID-19 lockdown in the UK, I have: Eaten large meals or snacks" **RO:** A lot less/Less/A little less/The same amount/A little more/More/A lot more **M/I:** "Compared to before the COVID-19 lockdown in the UK, I have: Snacked"	Compared to before lockdown: 3% ate a lot less large meals or snacks 8% ate less large meals or snacks 10% ate a little less large meals or snacks 34% ate the same amount of large meals or snacks 26% ate a little more large meals or snacks 14% ate more large meals or snacks

	RO: A lot less/Less/A little less/The same amount/A little more/More/A lot more	4% ate a lot more large meals or snacks. 5% snacked a lot less 8% snacked less 10% snacked a little less 22% snacked the same amount 27% snacked a little more 21% snacked more 8% snacked a lot more
Sidor & Rzymski, 2020[60]	**M/I:** "Indicate the number of meals eaten per day during quarantine: **RO:** One/two/three/four/five/ six or more **M/I:** "Did you snack more frequently than usual during quarantine? " **RO:** decidedly yes /yes/ hard to decide/ no/ decidedly no" **M/I:** "Indicate the number of snacks eaten per day during quarantine" **RO:** None/one/ two/ three/four or more	51.8% snacked between meals more frequently Most frequent number of meals per day during quarantine: three (30.3%) four (39.3%), Most frequent number of snacks per day during the quarantine: one (28.3%) two (36.1%)
Wang et al., 2020[72]	**M/I:** Food consumption questionnaire adapted from the online nutritional survey of Guangdong Nutrition Society and Sun Yat-sen University [measure is not in English, but can be found here: https://www.wjx.cn/m/59273857.aspx] Translated: **M/I:** "your staple food intake during the pandemic compared to before the pandemic" **RO:** increase/ reduce/ no significant changes	23.1% reduced their daily eating frequency 17.3% increased their daily eating frequency, and 60% reported no changes in eating frequency
Yılmaz et al., 2020[71]	**M/I:** Main meal in COVID-19 pandemic **RO:** Increased/Not changed/Decreased **M/I:** Snacks in COVID-19 pandemic **RO:** Increased/Not changed/Decreased **M/I:** Mean meal [daily number of meals consumed before the COVID-19 pandemic] **RO:** 1/2/3 **M/I:** Snacks [daily number of snacks consumed before the COVID-19 pandemic] **RO:** 1/2/3	71% no change in the number of main meals 23% increased number of main meals 6% decreased in the number of main meals 57.5% no change in the number of snacks 38% increased the number of snacks 4.5% decreased the number of snacks 58.3% consumed two main meals per day and 43.9% consumed one snack before COVID-19. During COVID-19, 23.0% reported an increase in the number of meals and 38.0% an increase of snacks.

[a] The response options stated here are quoted directly from Di Renzo, Gualtieri, Pivari, et al., 2020.[67] There was no reporting on the "Yes, I eat out of the meals" response option.

Table 5. Measures and Findings for Changes in the Timing of Eating During the Initial Months of the COVID-19 Pandemic

Citation	Measure/Items (M/I) & Response Options (RO)	Findings
Papandreou et al., 2020[54]	**M/I:** The Dutch Eating Behavior Questionnaire (DEBQ)[135] was utilized to assess eating behaviors.	59.8% of the Spain sample and 51.7% of the Greece sample reported that they do follow same hours/number of meals during the pandemic
Poelman et al., 2021[56]	**M/I:** Participants asked to indicate if they ate in a different way than usual during lockdown (with more awareness, taking more time, during different occasions, more often and snacking more frequently) **RO:** Fully disagree (1) to fully agree (5). Calculated the number of participants that (fully) agreed on each of the items (score 4 or 5).	16.9% ate at different times 19% took more time eating
Sutaria et al., 2020[73]	**M/I: "**Has your eating schedule changed?" **RO:** Yes/No/ Maybe	During the pandemic 50.2% reported eating schedule changed during 38.6% reported no change in eating schedule 11.1% reported eating schedule "maybe" changed

Table 6. Measures and Findings for Changes in the Consumption of Fruits and Vegetables, Snacks, Sweets, Seafood and Fast Food During the Initial Months of the COVID-19 Pandemic

Citation	Measure/ Items (M/I) & Response Options (RO)	Fruits/ Vegetables	Fruits	Vegetables	Snacks	Sweets and/or bakery products	Fish and/or seafood	Fast Food
Bakhsh et al., 2021[43]	**M/I:** How has your consumption of the following foods changed during the pandemic: fruits and vegetables,…sweets (cake, chocolate, and ice cream), savory snacks (chips and salty biscuits)? **RO:** "Increased Intake, Decreased Intake, or No Change in the Intake."	I[a]=48% U[b]=43% D[c]=9%	N/A	N/A	Frequency of snacking: I=45% U=36% D=19% Savory Snacks: I=30% U=40% D=30%	Sweets: I=44% U=31% D=25%	N/A	N/A
Bann et al., 2020[75]	**M/I:** How many portions of fruit and vegetables do you eat a day? **RO:** "From 0 to ≥6; portion guidance was provided"	Portions of fruits and vegetables consumed pre-pandemic similar to during lockdown	N/A	N/A	N/A	N/A	N/A	N/A
Ben Hassen et al., 2020[63d]	**M/I:** How has your consumption of the following foods changed during the pandemic: Fruits/Vegetables,… Candy/Cakes/ Cookies/Pastries, Healthy Snacks, Unhealthy Snacks…? **RO:** "Much More, Moderately More, About the Same, Slightly Less, Much Less, First Time [meaning that their first time consuming the food was during the pandemic], or Never"	I=32.4% U=60% D=5.8%	N/A	N/A	Healthy Snacks: I=20.9% U=57.7% D=12.7% Unhealthy Snacks: I=12.2% U=41.4% D=32.4%	Candy, cookies, cakes, and pastries: I=24.6% U=43.3% D=28.7%	N/A	N/A
Bin Zarah et al., 2020[76]	**M/I:** How has your consumption of the following foods changed during the pandemic:…Sweets, Potato Chips or other salty snacks,…Starchy Vegetables,… Eggs/Chicken/Turkey,… Non-Starchy Vegetables/Salad, Fruit...Fish or shellfish? **RO:** Increased, Decreased, or No Change.	N/A	I=16.4% U=50.2% D=33.4%	Starchy Vegetables I=8.5% U=70% D=21.5% Non-starchy vegetables: I=14.3% U=57.5%	Salty Snacks: I=37.4% U=49.6% D=13%	Sweets such as candy, cookies, pies: I=43.9% U=43.5% D=12.6%	Fish or shellfish: I=14.9% U=68.4% D=16.7%	N/A

				D=28.2%				
Błaszczyk-Bębenek et al., 2020[44]	**M/I:** How frequently have you consumed the following foods before the pandemic and during the pandemic:… fishes,…fruits, vegetables, fast foods,… sweets…? **RO:** "(1) never, (2) 1–3 times a month, (3) once a week, (4) few times a week, (5) once a day, (6) few times a day" **M/I:** How many portions of each food did you consume both before and during the pandemic? **RO:** "(1) zero, (2) half a portion, (3) one, (4) two, (5) three, (6) four or more"	N/A	Frequency: No significant change Portion Size: No significant change	Frequency: No significant change Portion Size: No significant change	N/A	Sweets Frequency: Significant increase, p=0.0241 Sweets portion Size: Significant increase, p=0.0029	Fishes frequency: No significant change Fishes Portion size: No significant change	Frequency: Significant decrease, p=0.0001 Portion Size: Significant decrease, p<0.0001
Buckland et al., 2021[45]	**M/I:** How has your consumption of the following foods changed during the pandemic: sweet snacks, savory snacks,… fruit intake, vegetable intake? **RO:** "I eat a lot less, I eat a lot more, or I eat the same amount"	N/A	I=48% U=36% D=16%	I=49% U=40% D=11%	Sweet Snacks: I=28% U=46% D=26% Savory Snacks: I=28% U=49% D=22%	N/A	N/A	N/A
Carroll et al., 2020[47e]	**M/I:** How has your and your child's diets changed during the pandemic? **RO:** " …eating more/fewer fruit and vegetables, eating more/less snack foods, such as chips or cookies, eating more/fewer foods from fast food/take out restaurants."	Mothers: Eating Fewer=22% Eating More=20% Fathers: Eating Fewer=12% Eating More=32% Children: Eating Fewer=20% Eating More=24%	N/A	N/A	Mothers: Eating Fewer=4% Eating more=66% Fathers: Eating fewer=4% Eating more=58% Children: Eating fewer=6% Eating more=54%	N/A	N/A	Mothers Eating fewer=42% Eating more=10% Fathers: Eating fewer=44% Eating more=13% Children Eating fewer=26% Eating more=8%
Celik & Dane, 2020[77]	**M/I:** Which foods did you have a preference to consume both before and during the pandemic? **RO:**…vegetables, fruits,… bakery foods	N/A	Before=18.5% During=26.5%	Before=14.4% During=24.6%	N/A	Bakery Foods: Before=20% During=10%	N/A	N/A

Cheikh Ismail et al., 2020[66]	**M/I:** What meal types were your most consumed meals both before the pandemic and during the pandemic? **RO:** "…fast food…"	N/A	N/A	N/A	N/A	N/A	N/A	Significant decreased consumption, p<0.001
Cheikh Ismail et al., 2021[65]	**M/I:** What meal types were your most consumed meals both before the pandemic and during the pandemic? **RO:** "…, fast food…"	N/A	N/A	N/A	N/A	N/A	N/A	Significant decreased consumption, p<0.001
Chenarides et al., 2021[13d]	**M/I:** "'How much more or less have you consumed these foods since COVID-19 started?' for 10 major food groups: fresh produce,…fast food…" **RO:** "A lot more (5), A bit more (4), About the same (3), A little less (2), A lot less (1) and Do not consume"	I=27.53% U=54.59% D=16.84%	N/A	N/A	N/A	N/A	N/A	I=16.84% U=21.37% D=47.97%
Di Renzo, Gualtieri, Pivari, et al., 2020[67e]	**M/I:** "During this [quarantine] period, which of these foods are you consuming MORE than before?" **RO:** "…fruits, fresh vegetables, frozen vegetables,…industrial bakery products/sweets, fish, frozen fish, canned fish…snacks..." **M/I:** "During this [quarantine] period, which of these foods are you consuming LESS than before?" **RO:** "…fruits, fresh vegetables, frozen vegetables,…industrial bakery products/sweets, fish, frozen fish, canned fish…snacks..."	N/A	Fresh Fruit Reduced Intake=18% Increased Intake=15.3%	Packaging Vegetables Reduced Intake=6.0% Increased Intake=8.0% Fresh Vegetables Reduced Intake=17.3% Increased Intake=19.3%	Snacks: Reduced Intake=12.7% Increased Intake=9.3%	Packaging Sweets: Reduced Intake=16.7% Increased Intake=11.3%	Preserved Fish: Reduced Intake=4.7% Increased Intake=6.7% Frozen Fish: Reduced Intake=8.0% Increased Intake=9.3% Fresh Fish: Reduced Intake=24.7% Increased Intake=4.7%	N/A
Flanagan et al., 2021[68]	**M/I:** In an average week, how frequently did you engage in each of the following behaviors both before and during the pandemic:.. consuming less than two fruits and vegetables per day,… eating fast food two or more times,…eating sweets and desserts,…? **RO:** "usually/often, sometimes, or rarely/never"	N/A	Significant decrease in frequency of eating less than 2 serving per day, p<0.001	No significant change in the frequency of eating less than 2 servings per day	N/A	Significant increase in the frequency of eating sweets or desserts, p<0.001	N/A	Significant decrease in the frequency of eating two or more meals from fast food, p<0.001
Gallo et al., 2020[48]	**M/I:** Which foods did you consume in the last 24 hours?	N/A	N/A	N/A	Significant increase in two snack occasions	N/A	N/A	N/A

	RO: "Foods and beverages were entered by typing in specific search terms and selecting items from a returned list" Results compared to 2018 and 2019 studies				compared to one and energy density attributed to snacks for females			
Giacalone et al., 2020[61]	**M/I:** How has your frequency of snaking changed during the pandemic? How has your consumption of the following foods changed during the pandemic:…Vegetables, Fruit,…Fish, Pastries (commercial),… Fast Food? **RO:** Higher, Lower, or As Before.	N/A	I=11.1% U=64.0% D=24.9%	I=11.3% U=69.2% D=19.5%	I=41.7% U=47.5% D=10.8%	Pastries commercial: I=21.1% U=60.6% D=18.4%	I=15.8% U=75.8% D=8.4%	I=15.1% U=59.5% D=25.4%
Górnick et al., 2020[62]	**M/I:** Has your consumption of the following foods changed during the pandemic: vegetables, fruits,…fish and seafood,… fast foods, salty snacks, confectionary, sweetened spreads, commercial pastry, ice-cream and puddings, sweetened cereals and/or cereal bars,…? **RO:** "I eat more/I eat the same/I eat less/I didn't eat before and during the pandemic"	N/A	I=15.2% U=64.7% D=20.1%	I=18.5% U=62.1% D=19.4%	Salty Snacks: I=18.1% U=62.2% D=19.7%	Confectionary: I=32.5% U=48.7% D=18.8% Sweetened Spreads: I=3.7% U=91.6% D=4.7% Commercial Pastry: I=10.9% U=59.6% D=29.4% Ice Cream and Pudding: I=10.0% U=74.9% D=15.0% Sweetened Cereal and/or Cereal Bars: I=5.4% U=88.3% D=6.3%	I=6.8% U=76.2% D=17.0%	I=8.1% U=55.3% D=36.6%
Huber et al., 2021[50]	**M/I:** How has your consumption of the following foods changed during the pandemic: Confectionaries,…Fruits, Vegetables?	N/A	I=33% U=52% D=14.5%	I=31.5% U=53.5% D=15%	N/A	Confectionaries: I=44.5% U=27.5%	N/A	N/A

	RO: Increased, Decreased, or Unchanged.					D=27.5%		
Husain & Ashkanani, 2020[69]	**M/I:** How frequently do you eat each of the following foods: fruit...vegetables...fish and seafood? **RO:** "Never, less than 1/w, 1-2/w, 3-4/w,5-6/w, 7 or more, I do not know, or none. The answer alternatives for fruits and vegetables were less than 1/d, 1/d, 2/d,3/d, 4 or more, none, or I do not know"	N/A	Before: None=8% Less than 1/d=31.1% 1/d=37.8% 2/d=14.9% 3/d=4.1% 4 or more=2.2% I do not know=1.9% During: None=9.2% Less than 1/d=29.2% 1/d=35.4% 2/d=18.3% 3/d=4.3% 4 or more=1.7% I do not know=1.9%	Before: None=7% Less than 1/d=22.4% 1/d=36.4% 2/d=20.5% 3/d=7.7% 4 or more=4.1% I do not know=1.9% During: None=8.2% Less than 1/d=23.1% 1/d=33.7% 2/d=21.4% 3/d=9.2% 4 or more=2.2% I do not know=2.2%	N/A	N/A	Before: Never=10.6% Less than 1/w=31.6% 1-2/w=47.0% 3-4/w=8.7% 5-6/w=0.2% 7 or more=0.5% I don't know=1.4% During: Never=26.5% Less than 1/w=33.0% 1-2/w=34.5% 3-4/w=4.3% 5-6/w=0.2% 7 or more=0.2% I don't know=1.2%	N/A
Kansiime et al., 2021[40e]	**M/I:** How often did you consume the following foods both before the pandemic and during the pandemic: fruits, vegetables, fish and seafood…? **RO:** "rarely (once or twice a month), sometimes (3–10 times a month), and often (>10 times a month)" "frequent consumption variables that are equal to one if a respondent selected 'often (>10 times a month)' and zero otherwise, were computed."	N/A	Percent of participants who reported a frequent consumption (>10 times per month) Kenya: Before=57.6% During=22.4% Uganda: Before=60.8% During=28.8%	Percent of participants who reported a frequent consumption (>10 times per month) Kenya: Before=76.8% During=67.2% Uganda: Before=64% During=35.2%	N/A	N/A	Percent of participants who reported a frequent consumption (>10 times per month) Kenya: Before=22.4% During=6.4% Uganda: Before=28.8% During=12.8%	N/A
Kriaucioniene et al., 2020[51]	**M/I:** How has your consumption of the following foods changed during the pandemic: Vegetables, Fruits,…Fish-Seafood,…Commercial Pastries, Fast Food…Snacking? **RO:** Higher, Lower or As usual	N/A	I=22.1% U=63.2% D=14.7%	I=18.8% U=66.2% D=15.0%	I=45.1% U=45.1% D=9.8%	Commercial pastries such as cookies, custards, sweets: I=18.9% U=55.2%	I=7.5% U=78.3% D=14.3%	I=6.7% U=51.9% D=41.3%

						D=26.0%		
Lamarche et al., 2021[78]	**M/I:** Which of the following foods did you eat in the last 24 hours? **RO:** … total vegetables,…seafoods and plant proteins, added sugars,… whole fruits,…total fruits	N/A	Whole fruits: Significant reduced consumption Total fruits: Significant reduced consumption	Total vegetables: Significant increased consumption Greens and beans: Significant increased consumption	N/A	Added Sugars: Significant reduced consumption	Seafood and plant proteins: Significant increased consumption	N/A
López-Bueno et al., 2020[79]	**M/I:** "How many fresh fruit and vegetables do you usually eat daily?" **RO:** 0, 1, 2, 3, 4, 5, or more than 5 Reporting a consumption of less than three fresh fruit or vegetables a day was considered a health risk behavior.	Significant decrease in consuming fewer than three fresh fruits or vegetables a day, p=0.011	N/A	N/A	N/A	N/A	N/A	N/A
Malta et al., 2020[80]	**M/I:** "Before the pandemic how many days a week did you usually eat any of the following foods: greens and vegetables, fruit,…savory snacks, chocolate/sweet biscuits/pieces of tart?" "During the pandemic, how frequently do you eat these foods now?" **RO:** 5 days or more (considered to be regular consumption); 2 to 4 days; one day or less	N/A	Regular consumption of fruit: Before=32.8% During=31.9%	Regular consumption of greens and vegetables: Before=37.3% During=33.0%	Savory snacks more than 2 days: Before=9.5% During=13.2%	Chocolate/sweet biscuits/pieces of tart more than 2 days: Before=41.3% After=47.1%	N/A	N/A
Matsungo & Chopera, 2020[81d,e]	**M/I:** How has your consumption of the following foods changed during the pandemic: Dark Green Leafy Vegetables, Other Vegetables, Other Vitamin-A Rich Fruits, Other Fruits…? **RO:** "1=less/decreased, 2=same/did not change, 3=more/increased, or 4=not applicable "	Other vitamin A rich fruits and vegetables: I=12.5% U=25% D=58.4%	Other Fruits: I=12.5% U=20.9% D=62.6%	Dark green leafy vegetables I=29.2% U=33.4% D=29.2% Other vegetables I=12.5% U=37.5% D=45.9%	N/A	N/A	N/A	N/A

Murphy et al., 2021[82]	**M/I:** How many portions of fruit and vegetables did you consume per day both before and during the pandemic?	N/A	Significant increase in the portions of fruit consumed per day	Significant increase in the portions of vegetables consumed per day	N/A	N/A	N/A	N/A
Pakravan-Charvadeh et al., 2020[83]	**M/I:** Which of the following foods did you consume before the pandemic? Which of the following foods did you consume during the pandemic? Cereals, Vitamin A-Rich Vegetables and Tubers,…Dark Green Leafy Vegetables, Other Vegetables, Vitamin A-rich fruits, Other fruits (i.e., wild fruits and 100% fruit juices made from fruits), Fruits,…Fish,..Sweets **RO:** Yes or No	N/A	Vitamin-A rich fruits/"other" fruits/ fruits: No significant change	Vegetables: Significant decreased consumption, p=0.05 Dark Green Leafy Vegetables: Significant decreased consumption, p=0.001 Vitamin-A rich vegetables and tubers/" other" vegetables: No significant change	N/A	Sweets: Significant decreased consumption, p=0.001	Fish: No significant change	N/A
Papandreou et al., 2020[54]	**M/I:** Did you consume more pastries during the pandemic? **RO:** "No, less than 3 pieces per week, or more than 3 pieces per week" **M/I:** Did the number of snacks you consumed between meals increase during the pandemic? **RO:** "Yes or no"	N/A	N/A	N/A	Spain: Yes=34.1% No=65.9% Greece: Yes=40.8% No=59.2%	Pastries: Spain: No=69.4% Less than 3/w=19.7% More than 3/w=10.9% Greece: No=62.2% Less than 3/w=12.6% More than 3/w=25.2%	N/A	N/A

Pellegrini et al., 2020[55]	**M/I:** Has your consumption changed: the number of snacks you consume a day,… fruits and vegetables, sweets? **RO:** "I don't consume those foods usually, is less than before quarantine, is the same as before quarantine, is more than before quarantine"	I=27.3% U=54% D=18%	N/A	N/A	Don't Consume=28 % I=32.7% U=28% D=11.3%	Sweets: Don't Consume=16 % I=50% U=22% D=12%	N/A	N/A
Radwan et al., 2020[57]	**M/I:** Which of the following foods did you consume more of during the pandemic? **RO:** "…salty snacks, sweet snacks…"	N/A	N/A	N/A	Salty Snacks: 21% reported consuming more during COVID Sweet snacks: 7.1% reported consuming more during COVID	N/A	N/A	N/A
Reyes-Olavarría et al., 2020[58]	**M/I:** How has your consumption of vegetables and fruits changed during the pandemic? **RO:** "Less than before/same than before/more than before"	I=30.9% U=48.4% D=20.7%	N/A	N/A	N/A	N/A	N/A	N/A
Rodríguez-Pérez et al., 2020[84]	**M/I:** How has your fast-food frequency changed during the pandemic? How has your snacking frequency changed during the pandemic? How has your consumption of the following foods changed during the pandemic:…Vegetables, Fruits,…Fish, Non-Homemade Pastries...? **RO:** Higher, Lower, As Before	N/A	I=18.3% U=67.6% D=13.6%	I=16.7% U=71% D=11.8%	I=37.6% U=46.7% D=15.7%	Non-homemade pastries I=21% U=59% D=20%	I=8% U=72% D=21%	I=5.1% U=60.0% D=34.9%
Sánchez-Sánchez et al., 2020[85]	**M/I:** "How many portions of vegetables do you consume every day? (Garnishes and accompaniments would be ½ portion, 1 portion is equal to 200g)" **RO:** "1 or less, 2 or more, none of them in salad or raw, or 2 or more, some of them in salad or raw." **M/I:** "How many pieces of fruit, including fruit juice, do you consume a day? **RO:** "2 or less per day, 3 or more per day"	N/A	Significant increased consumption, p<0.001	Significant increased consumption, p=0.032	N/A	Industrial Bakery Foods: Significant increased consumption, p<0.001	Significant increased consumption, p<0.001	N/A

	M/I: "How many portions of fish/seafood do you consume per week? (1 dish, piece, or portion = 100–150 g of fish or 4–5 pieces or 200 g of seafood)" **RO:** "2 or less portions per week, 3 or more portions per week" **M/I:** "How many times per week do you consume industrial bakery (non-home made) foods , like biscuits, puddings, sweets, or cakes?" **RO:** "1 or less portions per week, 2 or more portions per week"							
Scarmozzino & Visioli, 2020[59]	**M/I:** "Have you changed your fresh fruit and vegetables consumption during the lockdown?" **RO:** "Yes, it increased, I increased only the consumption of canned fruits and vegetables, No, I have been eating more or less the usual amount, or Yes, I decreased it" **M/I:** "Have you changed your consumption of other kinds of sweet food (chocolate, spreads, cakes, ice creams) during the lockdown?" **RO:** "Yes, it increased, I have been consuming more or less the usual amount, or Yes, I decreased it" **M/I:** "Have you changed your consumption of sweet or salty snacks during the lockdown?" **RO:** "Yes, it increased, I have been consuming more or less the usual amount, or Yes, I decreased it"	I=21.2% I (canned)=0.9% U=69.2% D=8.7%	N/A	N/A	Salty or sweet snacks: I=23.5% U=57.6% D=18.9%	Sweet food (chocolate, spreads, cakes, ice creams) I=42.5% U=44.0% D=13.5%	N/A	N/A
S. V Sharma et al., 2020[86]	**M/I:** How has your consumption of fruits and vegetables changed because of COVID-19? **RO:** Increased, Decreased, Stayed the Same	I=30.2% U=28.4% D=41.4%	N/A	N/A	N/A	N/A	N/A	N/A
Werneck et al., 2020[87]	**M/I:** How frequently did you consume fruit or vegetables both before the pandemic and during the pandemic quarantine? Reporting eating fruits or vegetables less than five days a week was classified as low frequency	Participants without depression: Low frequency of fruit or vegetable Before=77.5%	N/A	N/A	N/A	N/A	N/A	N/A

		During=78.1% Participants with depression: Low frequency of fruit or vegetable Before=81.6% During=81.6%						
Yılmaz et al., 2020[71]	**M/I:** How has your consumption of the following foods changed during the pandemic: Vegetables, Fruits, Snacks… **RO:** Increased, Decreased, or Unchanged.	N/A	I=49.1% U=49.4% D=1.5%	I=40.5% U=58.4% D=1.0%	I=38% U=57.5% D=4.5%	N/A	N/A	N/A
Zhang et al., 2020[88]	**M/I:** How has your consumption of the following food types changed during the pandemic: seafood… snacks and beverages? **RO:** Increase, Unchanged, or Decreased	N/A	N/A	N/A	Consuming Snacks and beverages: I=25% U=38% D=38%	N/A	Seafood: I=9.5% U=37.5% D=53%	N/A

[a] I represents an increase in consumption

[b] U represents consumption was unchanged

[c] D represents a decrease in consumption

[d] Findings are presented only for response options related to an increase, decrease, or no change, thus percentages reported will not add to equal 100%. Remaining percentages align with the alternative response options noted in the measures section including "never" and "first time" for Ben Hassen et al., 2020, "do not consume" for Chenarides et al., 2021, and "not applicable" for Matsungo & Chopera, 2020.

[e] Studies where values were estimated from a figure

Table 7. Measures and Findings for Changes in the Consumption of Frozen Foods, Dairy Products, Homemade Foods, Legumes, Breads, Grains, and Meats During the Initial Months of the COVID-19 Pandemic

Citation	Measure/ Items (M/I) & Response Options (RO)	Frozen Food	Dairy Products	Homemade Foods	Legumes	Breads/Grains	Meats
Alhusseini & Alqahtani, 2020[74]	**M/I:** "[Before the pandemic] How often do you eat home-cooked meals per week?" "[During the pandemic] How often do you eat home-cooked meals per week?" **RO:** "0, 1-2 times/week, 3-6 times/week, or daily"	N/A	N/A	Significant increase, $p<0.001$	N/A	N/A	N/A
Bakhsh et al., 2021[43]	**M/I:** How has your consumption of the following foods changed during the pandemic:…dairy products, meat, fish, poultry,…? **RO:** "Increased Intake, Decreased Intake, or No Change in the Intake."	N/A	I[a]=26% U[b]=12% D[c]=62%	N/A	N/A	N/A	Meat/Fish/ Poultry: I=34% U=57% D=9%
Ben Hassen et al., 2020[63d]	**M/I:** How has your consumption of the following foods changed during the pandemic:…Meat,…Packaged Frozen Foods? **RO:** "Much More, Moderately More, About the Same, Slightly Less, Much Less, First Time [meaning that their first time consuming the food was during the pandemic], or Never"	I=14.8% U=47.8 % D=21.8%	N/A	N/A	N/A	N/A	Meat General: I=11.2% U=72.6% D=12.5%
Bin Zarah et al., 2020[76]	**M/I:** How has your consumption of the following foods changed during the pandemic: ...Sweets,...Brown Rice or Whole Grain Pasta, White Rice or Pasta,… Dark Bread, White Bread, Cold Breakfast Cereals,.. Processed Meats, Beef/Pork/Lamb, Eggs/Chicken/Turkey,… Dairy and Dairy Alternatives? **RO:** Increased, Decreased, or No Change.	N/A	Dairy and dairy alternatives: I=8.3% U=70.1% D=21.6%	N/A	N/A	Brown rice or whole-grain pasta: I=8.1% U=76.8% D=15.1% White rice or pasta: I=26.8% U=62.5% D=10.7% Dark Bread: I=8.7% U=77.2% D=14.1% White Bread: I=19%	Processed Meat: I=19.9% U=63.7% D=16.4% Beef, Pork, or Lamb: I=20.4% U=64.3% D=15.3% Eggs, Chicken, or Turkey: I=11.1% U=57.9% D=31%

						U=70.4% D=10.6% Cold Breakfast cereals: I=22.3% U=67.4% D=10.3%	
Błaszczyk-Bębenek et al., 2020[44]	**M/I:** How frequently have you consumed the following foods before the pandemic and during the pandemic: white bread, whole meal bread, white rice/white pasta, buckwheat/oats,…milk, fermented milk, fresh cheeses, cheeses, cold meats, red meats, white meats,… pulses,…tinned meats…? **RO:** "(1) never, (2) 1–3 times a month, (3) once a week, (4) few times a week, (5) once a day, (6) few times a day" **M/I:** How many portions of each food did you consume both before and during the pandemic? **RO:** "(1) zero, (2) half a portion, (3) one, (4) two, (5) three, (6) four or more"	N/A	Frequency milk/fermented milk/ cheese/fresh cheese/butter: No significant change Portion size milk/fermented milk/cheese/fresh cheese/butter: No significant change	N/A	Pulses frequency: No significant change Pulses Portion size: No significant change	White bread Portion Size: Significant decrease, p=0.040 White bread/Whole meal bread/white rice, white pasta/Buckwheat oats Frequency: No significant change Whole meal bread/white rice, white pasta/Buckwheat oats: Portion size: No significant change	Tinned meats Frequency: Significant increase, p=0.0004 Tinned Meats Portion size: Significant increase, p=0.0390 Red Meats/White Meats/Cold Meats frequency: No significant change Red Meats Portion size: Significant decrease, p=0.0199 White Meats/Cold Meats Portion size: No Significant Change
Celik & Dane, 2020[77]	**M/I:** Which foods did you have a preference to consume both before and during the pandemic? **RO:** Meat	N/A	N/A	N/A	N/A	N/A	Meat General: Before=29.2% During=22.9%
Cheikh Ismail et al., 2020[66]	**M/I:** What meal types were your most consumed meals both before the pandemic and during the pandemic?	Significant decreased consumption, p=0.032	N/A	Significant increased consumption, p<0.001	N/A	N/A	N/A

	RO: "Homemade, frozen ready-to-eat meals…"						
Cheikh Ismail et al., 2021[65]	**M/I:** What meal types were your most consumed meals both before the pandemic and during the pandemic? **RO:** "Homemade, frozen ready-to-eat meals,…"	No significant change	N/A	Significant increased consumption, p<0.001	N/A	N/A	N/A
Chenarides et al., 2021[13d]	**M/I:** "'How much more or less have you consumed these foods since COVID-19 started?' for 10 major food groups:…dairy, meat, grains,…frozen food,…" **RO:** "A lot more (5), A bit more (4), About the same (3), A little less (2), A lot less (1) and Do not consume"	I=25.43% U=53.19% D=16.49%	I=19.16% U=65.27% D=12.66%	N/A	N/A	Grains: I=28.69% U=59.35% D=10.22%	Meat General: I=19.86% U=54.36% D=22.18%
Di Renzo, Gualtieri, Pivari, et al., 2020[67e]	**M/I:** "During this [quarantine] period, which of these foods are you consuming MORE than before?" **RO:** "None…pasta and cereals, bread, homemade pizza, homemade pastries,…ham and processed meat, dairy products, cheese, cow's milk and yogurt…Legumes, white meat, red meat…" **M/I:** "During this [quarantine] period, which of these foods are you consuming LESS than before?" **RO:** "None…pasta and cereals/ bread/homemade pizza/homemade pastries…processed meat/dairy products/ cheese/cow's milk and yogurt,…legumes/white meat/red meat…"	N/A	Dairy Products: Reduced Intake=4% Increased Intake=13.3% Milk and yogurt: Reduced Intake=4.0% Increased Intake=9.3%	Homemade Sweets: Reduced Intake=4% Increased Intake=45.4% Homemade Pizza: Reduced Intake=4.7% Increased Intake=35.4%	Reduced Intake=4.7% Increased Intake=15.3%	Fresh Bread: Reduced Intake=9.3% Increased Intake=17.3% Cereals: Reduced Intake=5.3% Increased Intake=24.7%	Preserved Meat: Reduced intake=12.7% Increased intake=13.3% Processed Meat: Reduced intake=6.7% Increased intake=3.3% Red Meat: Reduced intake=8.0% Increased intake=8.7% White Meat: Reduced Intake=4.7% Increased Intake=12.0%
Giacalone et al., 2020[61]	**M/I:** How has your consumption of the following foods changed during the pandemic…Red Meat, Legumes,… Pastries (homemade)…? **RO:** Higher, Lower, or As Before.	N/A	N/A	Homemade Pastries: I=38.1% U=53.8% D=8.1%	I=7.1% U=84.4% D=8.6%	N/A	Red Meat: I=11.5% U=76.2% D=12.3%
Górnick et al., 2020[62]	**M/I:** Has your consumption of the following foods changed during the pandemic:…whole grain cereal products, low fat meat and/or	N/A	I=20.8% U=71.0% D=8.2%	Homemade Pastry: I=39.9% U=51.1%	I=13.9% U=77.7% D=8.5%	Whole Grain Products: I=16.3% U=72.3%	Low Fat Meat and/or Eggs: I=15.7% U=74.7%

	eggs,… milk and milk products, processed meats,… homemade meals,…? **RO:** "I eat more/I eat the same/I eat less/I didn't eat before and during the pandemic"			D=9.0% Homemade Meals: I=48.0% U=48.8% D=3.1%		D=11.4%	D=9.7% Processed Meat: I=10.9% U=71.4% D=17.7%
Huber et al., 2021[50]	**M/I:** How has your consumption of the following foods changed during the pandemic:…Bread, Meat, Dairy…? **RO:** Increased, Decreased, or Unchanged.	N/A	I=25% U=58.5% D=16.5%	N/A	N/A	Bread: I=32.5% U=40% D=27.5%	Meat General: I=16% U=56.5% D=27.5%
Husain & Ashkanani, 2020[69]	**M/I:** How frequently do you eat each of the following foods: red meat, chicken,… processed meat…? **RO:** "Never, less than 1/w, 1-2/w, 3-4/w,5-6/w, 7 or more, I do not know, or none. **M/I:** What type of milk do you consume most frequently? **RO:** "None/whole milk/semi-skimmed/skimmed/soy milk/almond milk/other (rice/goat milk)/do not know" **M/I**: What type of bread do you consume most frequently? **RO:** "Other/white/brown or brown seeds/ whole wheat/[non-brown] seeds/None"	N/A	Before: None=23.4% Whole milk=29.9% Semi-skimmed=23.9% Skimmed=13.5% Soy milk=1.0% Almond milk=5.1% Other (rice/goat)=2.7% During: None=23.9% Whole milk=30.8% Semi-skimmed=24.8% Skimmed=11.3% Soy milk=1.2% Almond milk=3.6% Other (rice/goat)=3.1%	N/A	N/A	Before: Other=2.4% White=42.9% Brown/brown seeds=44.1% Whole wheat=9.4% Seeds=0.0% None=1.2% During: Other=1.7% White=48.0% Brown/brown seeds=39.5% Whole wheat=9.6% Seeds=0.0% None=1.2%	Processed Meat: Before: Never=68.4% Less than 1/w=17.8% 1-2/w=9.2% 3-4/w=3.1% 5-6/w=0.5% 7 or more=0.0% I don't know=1.0% During: Never=69.4% Less than 1/w=16.1% 1-2/w=7.0% 3-4/w=5.1% 5-6/w=1.0% 7 or more=0.2% I don't know=1.2% Red Meat: Before: Never=7.7% Less than 1/w=17.3% 1-2/w=49.4% 3-4/w=22.7% 5-6/w=1.2% 7 or more=0.7% I don't know=1% During: Never=10.1%

							Less than 1/w=20.7% 1-2/w=47.5% 3-4/w=18.1% 5-6/w=2.2% 7 or more=0.5% I don't know=1% Chicken: Before: Never=3.6% Less than 1/w=4.3% 1-2/w=35.9% 3-4/w=41.4% 5-6/w=10.6% 7 or more=3.1% I don't know=1% During: Never=4.8% Less than 1/w=6.5% 1-2/w=34.5% 3-4/w=39.5% 5-6/w=11.3% 7 or more=2.7% I don't know=0.7%
Kansiime et al., 2021[40e]	**M/I:** How often did you consume the following foods both before the pandemic and during the pandemic:…, meat (goat, beef, mutton, etc.), and poultry products? **RO:** "rarely (once or twice a month), sometimes (3–10 times a month), and often (>10 times a month)"	N/A	N/A	N/A	N/A	N/A	Meat General: Percent of participants who reported a frequent consumption (>10 times per month) Kenya: Before=41.6% During=16% Uganda: Before=51.2% During=22.4%

							Poultry: Percent of participants who reported a frequent consumption (>10 times per month) Kenya: Before=38.4% During=19.2% Uganda: Before=41.6% During=28.8%
Kriaucioniene et al., 2020[51]	**M/I:** How has your consumption of the following foods changed during the pandemic:…Pulses,…Red Meats/Hamburgers/Sausages…Homemade pastries such as cookies, custards, sweets, or cakes? **RO:** Higher, Lower or As usual	N/A	N/A	Homemade pastries such as cookies, custards, sweets, or cakes: I=37.7% U=50.8% D=11.5%	Pulses: I=9.1% U=82.4% D=8.5%	N/A	Red meats, hamburgers, sausages: I=12.2% U=69.9% D=17.9%
Lamarche et al., 2021[78]	**M/I:** Which of the following foods did you eat in the last 24 hours? **RO:** Whole grains,.. refined grains,…total dairy,…total proteins?	N/A	Total diary: Significant increased consumption	N/A	N/A	Refined Grains: Significant reduced consumption Whole Grains: Significant increased consumption	Total proteins: Significant increased consumption
Malta et al., 2020[80]	**M/I:** "Before the pandemic how many days a week did you usually eat any of the following foods: …beans, frozen food…?" "During the pandemic, how frequently do you eat these foods now?" **RO:** "5 days or more; 2 to 4 days; one day or less"	Frozen Food more than 2 days: Before=10.0% During=14.6%	N/A	N/A	Regular consumption of beans: Before=43.3% During=40.9%	N/A	N/A
Matsungo & Chopera, 2020[81d,e]	**M/I:** How has your consumption of the following foods changed during the pandemic:…Meat and Meat Groups,… Cereal Breads and Tubers, Dairy Products…Pulses/legumes...?	N/A	I=8.3% U=41.7% D=45.9%	N/A	I=16.7% U=37.5% D=33.4%	Cereal, breads, and tubers: I=16.7% U=37.5% D=41.7%	Meat General: I=8.3% U=45.9% D=41.7%

	RO: "1=less/decreased, 2=same/did not change, 3=more/increased, or 4=not applicable "						
Pakravan-Charvadeh et al., 2021[83]	**M/I:** Which of the following foods did you consume before the pandemic? Which of the following foods did you consume during the pandemic? Cereals…Organ Meat, Flesh Meats, Meats,..Legumes/Nuts/Seeds, Milk and Milk Products… **RO:** Yes or No	N/A	Milk and Milk Products: No significant change	N/A	Legumes, Nuts, and Seeds: Significant increased consumption, p=0.001	Cereals: No significant change	Organ Meat: Significant decreased consumption, p=0.001 Flesh Meat: No significant change
Pellegrini et al., 2020[55]	**M/I:** Has your consumption changed: the number of snacks you consume a day, cereals (pasta, rice, other), sources of protein (meat, fish, eggs, cheese, legumes),…? **RO:** "I don't consume those foods usually, is less than before quarantine, is the same as before quarantine, is more than before quarantine"		N/A	N/A	protein (meat, fish, eggs, cheese, legumes): Don't Consume=0.7% I=27.3% U=54% D=18%	cereals (pasta, rice, other): Don't Consume=2.7% I=28% U=53.3% D=16%	protein (meat, fish, eggs, cheese, legumes): Don't Consume=0.7% I=27.3% U=54% D=18%
Reyes-Olavarría et al., 2020[58]	**M/I:** Was cooking performed more than before, less than before, or maintained? **RO:** "More than before/same [as] before/less than before"	N/A	N/A	I=59.6% U=34.7 D=5.7%	N/A	N/A	N/A
Rodríguez-Pérez et al., 2020[84]	**M/I:** How has your fast-food frequency changed during the pandemic? How has your consumption of the following foods changed during the pandemic:…Red Meat,… Legumes…? **RO:** Higher, Lower, As Before	N/A	N/A	N/A	I=15% U=78% D=8%	N/A	Red Meat: I=8% U=68% D=24%
Sánchez-Sánchez et al., 2020[85]	**M/I**:"How many portions of butter, margarine, or cream do you consume every day? Individual portion=2g" **RO:** "1 or less per day, 2 or more per day." **M/I:** "How many portions of legumes do you consume per week? (1 dish or portion is 150 g): **RO:** "2 or less portions per week, 3 or more portions per week" **M/I:** "How many portions of red meat, hamburgers, sausages, or cold meat do you consume every day? (Portion 100–150 g)"	N/A	Butter, Margarine, or Cream: Significant increased consumption, p<0.001	N/A	Significant increased consumption, p<0.001	N/A	Red meat, Hamburger, Sausages, or Cold Meat: Significant increased consumption, p<0.001

	RO: "1 or less per day, 2 or more per day"						
Yılmaz et al., 2020[71]	**M/I:** How has your consumption of the following foods changed during the pandemic: …Red Meat/Chicken/Fish, Dairy Products…? **RO:** Increased, Decreased, or Unchanged.	N/A	I=41.0% U=58.5% D=0.5%	N/A	N/A	N/A	Red meat, chicken, and fish: I=32.1% U=65.8% D=2.1%
Zhang et al., 2020[88]	**M/I:** How has your consumption of the following food types changed during the pandemic: frozen food, imported frozen food…? **RO:** Increase, Unchanged, or Decreased	Frozen Food: I=19% U=40% D=41% Imported Frozen Food: I=3.3% U=40% D=57%	N/A	N/A	N/A	N/A	N/A

[a] I represents an increase in consumption

[b] U represents consumption was unchanged

[c] D represents a decrease in consumption

[d] Findings are presented only for response options related to an increase, decrease, or no change, thus percentages reported will not add to equal 100%. Remaining percentages align with the alternative response options noted in the measures section including "never" and "first time" for Ben Hassen et al., 2020, "do not consume" for Chenarides et al., 2021, and "not applicable" for Matsungo & Chopera, 2020.

[e] Studies where values were estimated from a figure

Table 8. Measures and Findings for Changes in Healthy Eating During the Initial Months of the COVID-19 Pandemic

Citation	Measure/Items (M/I) & Response Options (RO)	Findings
Alhusseini & Alqahtani, 2020[74]	**M/I:** "How would you rate your overall habits of eating healthy foods?" (Before and during COVID-19). **RO:** poor/ fair/ good/ very good/ excellent	Statistically significant increase in respondents rating of their eating healthy food as very good/excellent (22.3% to 29.5%; $p<0.001$).
Almandoz et al., 2020[89]	**M/I: "**As a result of COVID-19, do you find it is easier or more difficult to stick to healthy diet menus and plans?"	61.2% reported greater challenge in following healthy diet plans. 25% reported no change.
Ammar et al., 2020[64]	**M/I:** "How likely are you to have an unhealthy diet/food?" Referenced for before and after confinement. Never/sometimes/most of the times/ always	Significantly higher reports of unhealthy eating during confinement ($t = -3.46$, $p < 0.001$, $d = 0.14$). Consuming unhealthy food increased for responses to most of the time (23.3% vs. 18.4%) and always (10.9% vs. 6.2%).
Ben Hassen et al., 2020[63a]	**M/I:** Change of eating or drinking habits during the COVID-19 pandemic for the healthy foods, unhealthy foods (e.g., fast food), healthy snacks, unhealthy snacks **RO:** Never/first time/much less/slightly less/ about the same/ moderately more/ much more	54.1% about the same healthy foods 16.6% much more healthy foods 15.7% moderately more healthy foods 6.3% slightly less healthy foods 2.8% much less healthy foods 4.4% never 0.2% first time 22.5% about the same unhealthy foods 3.5% much more unhealthy foods 6.3% moderately more unhealthy foods 11% slightly less unhealthy foods 33.5% much less unhealthy foods 22.2% never 1.0% first time 57.7% about the same healthy snacks 6.8% much more healthy snacks 14.1% moderately more healthy snacks 8% slightly less healthy snacks 4.7% much less healthy snacks 8.5% never 0.2% first time 41.4% about the same unhealthy snacks 2.8% much more unhealthy snacks 9.4% moderately more unhealthy snacks 12.6% slightly less unhealthy snacks 19.8% much less unhealthy snacks

		13.6% never 0.3% first time
Cancello et al., 2020[46]	**M/I:** "How do you evaluate the quality of your nutrition compared to before isolation for covid19?"	47% reported diet quality was like before 34% reported improved diet quality 19% reported worsened diet quality
Di Renzo, Gualtieri, Pivari, et al., 2020[67]	**M/I:** "Did your lifestyle and eating habits change[b] during the COVID-19 pandemic period?" **M/I:** "During this period, which of these foods are you consuming MORE than before?" **M/I:** "During this period, which of these foods are you consuming LESS than before?" Healthy food defined as fruit, vegetables, nuts and legumes Junk food is defined as packaged sweets and baked products, sweet beverages, savory snacks and dressing sauces	46.1% no change in lifestyle/eating habits 37.2% COVID-19 made habits worse 16.7% COVID-19 made habits improve 37.4% reported eating more healthy food; 35.8% ate less. (Defined as adherence to the Mediterranean diet) 29.8% reported a decrease in "junk food" consumption. Percent increase not reported
Do et al., 2020[90]	**M/I & RO:** "Reported their current… eating (less healthy versus unchanged or healthier) behaviors as compared with that before the pandemic"	5042 (96.8%) ate at an "unchanged or healthier" level [no distinction made]
Duong et al., 2020[91]	**M/I & RO:** Participants rated their eating behavior as less healthy, unchanged, and healthier	42.8% reported healthier eating behavior compared to before the pandemic. (Less healthy and unchanged eating behaviors were assessed together)
Flanagan et al., 2021[68]	**M/I:** Perception of overall healthy eating habits and weight change **M/I:** Optional long form was a modification of the Rapid Eating Assessment (REAP-s)[134]	20.7% perceived they were eating healthier and 35.6% reported eating less healthy The REAP-s increased (0.81±0.04, $p<0.001$), indicating overall healthier eating
Górnick et al., 2020[62]	**M/I:** Three patterns created: (1) Prohealthy-increased healthy foods & decreased non-recommended foods (2) Constant-relatively stable dietary patterns (3) Unhealthy-increased consumption of non-recommended foods & Decreased consumption of healthy ones Healthy foods- based on plant food (vegetables, legumes, fruits), healthy fats, and rich protein-low fat food.	53.0%- Constant eating pattern 27.6- Prohealthy eating pattern 19.4%- Unhealthy eating pattern
Ingram et al., 2020[92]	**M/I & RO:** "diet: 1 = 'a lot more unhealthy', 3 = 'about the same', 5 = 'a lot more healthy'"	34.1% diet remained the same. 28.1% diet was a little more unhealthy 12.8% diet was a lot unhealthier 18.8% diet was a little more healthy 6.3% diet was a lot healthier
Kansiime et al., 2021[40]	**M/I:** The Food Insecurity Experience Scale (FIES)[132]	Percent of people reporting unable to eat health/nutritious food before and during the pandemic. All are significant ($p<.01$)

		In total sample: 21% before, 55% during Kenya sample: 23% before, 56% during Uganda sample: 16% before, 51% during
Khubchandani et al., 2020[93]	**M/I & RO:** "overall perception of diet quality change" healthier than before the pandemic/ same as before the pandemic/worse than before the pandemic.	32% their diet is healthier than before 31% report their diet was worse than before 37% reporting no change in overall diet.
Marty et al., 2021[53]	**M/I:** Simplified PNNS-GS2 (sPNNS-GS2; an index to reflect the 2017 French main dietary recommendations)[136] "Less healthy food groups which consumption should be limited, i.e., red meat, processed meat, sugary foods, sweet-tasting beverages, alcoholic beverages, salt" 'healthier food groups carrying a positive score, i.e., fruits and vegetables, nuts, legumes, whole-grain food, milk and dairy products, fish and seafood	Scores on the sPNNS-GS2 significantly decreased during lockdown compared to before (0.8 vs 1.2 respectively; p<.001)
Pellegrini et al., 2020[55]	**M/I:** "During the lockdown period, the healthy foods that you prepare/consume:"	56% reported "I have not changed habits with respect to the type of food" 28% reported "I don't pay attention to how healthy a food is. I consume/prepare foods that give me satisfaction.". 16% reported "I consume/prepare more healthy foods, paying attention to the seasoning"
Pham et al., 2020[94]	**M/I:** Healthy intake- 5-item Healthy Eating Score (HES-5)[137]	Being under the lockdown associated with lower healthy dietary intake scores ($p < 0.001$).
Poelman et al., 2021[56]	**M/I & RO:** Participants healthy eating pre-lockdown on a five-point Likert scale (fully agree - full disagree). **M/I & RO:** If they "found it easier or more difficult than usual to make healthy food choices" and "if they ate healthier or less healthy than usual"	Pre-lockdown, most perceived their eating as healthy (81%) with 16.1% being neutral and 2.9 % reporting eating unhealthily. 82.7% no change in difficulty to eat healthy, 10.8% more difficult to eat healthy 6.5% easier to eat healthy 83.3% reported no difference in healthiness of food 9.6 % reported eating healthier 7.1% reported eating unhealthier
Robinson et al., 2021[70]	**M/I:** 'Compared to before the COVID-19 lock-down in the UK, I have …. ' followed by several items on barriers/facilitators to healthy eating **RO:** 7-point response scale 1 = A lot less frequently/ 4 = The same amount/ 7 = A lot more frequently **M/I:** Short 13 item food frequency questionnaire (SFFQ)[138c]	Below are the percent of people who agreed to the question 'compared to before the COVID- 19 lockdown in the UK, I have…' 77% been able to access healthy food 79% been able to afford healthy food 77% been able to plan healthy meals 83% known how to eat healthily in the current circumstances

		88% had time to eat healthily 83% had unhealthy food in the house 55% been motivated to eat healthily 49% fallen into unhealthy habits 43% been supported by others to eat healthily Nearly equal proportions said that their eating a healthy and balanced diet remained the same (31%), was less (17% a little less, 12% less, 6% a lot less), and was more (17% a little more, 12% more, 6% a lot more) Lower diet quality was related to higher BMI, lower education, being white, younger and a male.
Rossinot et al., 2020[95]	**M/I:** Self-evaluation of the change during the lockdown of their diet **RO:** Less balanced/ no change/ more balanced	54.1% unchanged 28.7% more balanced 17.1% less balanced
Sánchez-Sánchez et al., 2020[85]	**M/I:** Prevention with Mediterranean Diet questionnaire Healthy defined as high adherence	Adherence to Mediterranean diet increased (8% vs 4.7%).
Wang et al., 2020[72]	**M/I:** Not listed	23% of adults reported changed their diets to be healthier

[a] Findings related to healthy foods and unhealthy snacks from Ben Hassen et al., 2020[63] have percentages that do not add to be 100%. These results are presented in accordance with the original study.

[b] The original item from Di Renzo, Gualtieri, Pivari, et al., 2020[67] reads "Did your lifestyle and eating habits changed during the COVID-19 pandemic period?"

[c] Measure source as cited in Robinson et al., 2021[70] "Participants completed a UK-based short 13 item food frequency questionnaire (SFFQ) in which consumption frequencies of 'healthy' and 'unhealthy' key food groups (e.g. fruit, vegetables, wholegrains, sugary drinks, processed meat) during the last week are measured (Green et al., 2016)."

Table 9. Measures and Findings for Changes in Other Eating Behaviors During the Initial Months of the COVID-19 Pandemic

Citation	Behavior	Measure/Items (M/I) & Response Options (RO)	Findings
Adams et al., 2020[103]	Meal Skipping	**M/I:** Whether/ how often they cut meal sizes or skipped meals in the past 30 days because there was not enough money for food. **RO:** number of days/month ≥ 3 days considered food insecure	Parents reported cutting or skipping meals because of not enough money more often during the pandemic (11.0 ±7.5 days/month) compared to before COVID-19 (2.9 ±2.2 days/month)
Almandoz et al., 2020[89]	Meal Skipping	**M/I:** Food security: The 6-item US Adult Food Security Survey Module[139] **M/I:** Skipping meals? **RO:** Yes/No	12.1% of participants reported skipping meals (although 78.3% of the sample was not food insecure)
Ammar et al., 2020[64]	Uncontrolled Eating	**M/I:** Asked as before and during the pandemic "How often have you found yourself eating out of control" **RO:** Never/sometimes/ most of the time/always	Eating out of control was significantly higher during home confinement ($p<0.001$) 20.4% of participants indicated eating out of control most of the time during home confinement compared to 9.7% before confinement 9.6% of participants indicated they were always eating out of control during home confinement compared to 2.3% before confinement
Cheikh Ismail et al., 2020[66]	Meal Skipping	**M/I:** Meal skipping? **RO:** Yes/no **M/I:** Main reasons for skipping meals? **RO:** To reduce food intake, lack of time, to lose weight, lack of appetite, fasting	46.2% of people reported skipping meals during the pandemic compared to 65.5% skipping meals before the pandemic People reported the main reason they skipped meals during and before the pandemic was: To reduce food intake (29.1% during, 21.7% before) Losing weight (23.6% during, 18.5% before) Lack of time (30.6% during, 62.3% before) Lack of appetite (36% during, 27.7% before) Fasting (25.7% during, 10.3% before)
Cheikh Ismail et al., 2021[65]	Meal Skipping	**M/I:** Meal skipping? **RO:** Yes/no **M/I:** Main reasons for skipping meals? **RO:** To reduce food intake, lack of time, to lose weight, lack of appetite, fasting	45.1% of participants skipped meals during the pandemic compared to 64.4% of participants skipping meals from before the pandemic ($p<0.001$) People reported the main reason they skipped meals during and before the pandemic was: To reduce food intake (27.7% during, 18.6% before) Losing weight (23.8% during, 20.2% before) Lack of time (27% during, 60.8% before)

			Lack of appetite (37.9% during, 30.9% before) Fasting (26.4% during, 10% before)
Di Renzo, Gualtieri, Pivari, et al., 2020[67]	Meal Skipping	**M/I:** "Did you change the number of daily meals, during this period " **RO:** No, it didn't/Yes, I skip 1 or more of the main meals (breakfast, lunch, dinner)/Yes, I skip 1 or more of snacks between meals/Yes, I added 1 or more of the main meals/Yes, I added 1 or more of the snacks between meals/Yes, I eat out of the meals.[a]	17.5% reported skipping more snacks or meals 23.5% reported introducing more meals/snacks
Elmacloğlu et al., 2021[102]	Uncontrolled Eating Restrictive Eating	**M/I:** Uncontrolled eating, cognitive restriction, and emotional eating behavior: Eighteen items in total[140,141] **RO:** 1=absolutely true; 2=mostly true; 3=mostly false; and 4=absolutely false	Uncontrolled eating behavior significantly increased during the pandemic in "normal" and "overweight" individuals compared to before (p<.001). Compared to men, women's uncontrolled eating and cognitive restriction were higher during the pandemic compared to before. 22.14 % of participants reported increases in uncontrolled eating behavior 9.12% of participants reported increases in restrictive eating behaviors
Flaudias et al., 2020[97]	Binge Eating Restrictive Eating	**M/I:** Depression and Anxiety: The Hospital Anxiety and Depression Scale (HADS)[142] **M/I:** Perceived stress: The 10-item Perceived Stress Scale (PSS-10)[143] **M/I:** Eating behaviors: The body dissatisfaction and impulse regulation subscales of the Eating Disorder Inventory, 2nd edition (EDI-2)[144] an eating disorder screening tool (Sick, Control, One, Fat, Food [SCOFF])[145] and the Ideal Body Stereotype Scale (IBSS)[146b]	Binge eating (past 7 days) higher in women, those with higher BMI, greater perceived stress, higher stress related to lockdown, more anxiety, more depression, and probable eating disorders Dietary restriction (past 7 days) higher in women, younger students, those who are classified as "underweight" or "obese." Having scholarship associated with less restriction Higher stress related to the lockdown and anxiety was associated with a higher likelihood of current dietary restriction (past 7 days; p<.001) and anticipated restriction (next 2 weeks; p<.01). Higher eating disorder risk, body dissatisfaction, and endorsement of appearance ideals linked to report higher dietary restriction (p<.001).

			Anticipated bingeing (next 2 weeks) associated with higher age, depression, stress related to lockdown, and COVID media exposure, being "underweight," risk for eating disorder, and lower impulse regulation and body dissatisfaction. Anticipated dietary restriction (next 2 weeks) was higher for those who were younger, women, at risk of eating disorders, had high levels of body dissatisfaction, endorsement of appearance ideals, low impulse control and BMIs classified as "underweight" and "obese."
Haddad et al., 2020[104]	Restrictive Eating	**M/I:** The Eating Disorder Examination-Questionnaire (EDEQ)[147] **M/I:** 10 questions related to fear of COVID-19 (e.g., "Thinking about COVID-19 makes me feel anxious") **RO:** 5-point Likert scale ranging from 1 (not at all) to 5 (extremely) Higher scores indicate increased fear.	Greater fear of COVID-19, higher BMI, and physical activity predicted higher restraint scores $p<.001$.
Husain & Ashkanani, 2020[69]	Meal Skipping	**M/I & RO:** "Skipping meal breakfast; skipping meal snack (breakfast and lunch); skipping meal lunch; skipping meal snack between lunch and dinner; skipping meal dinner; none skipping meal"	Changes in meal skipping were seen for: Breakfast: 41.7% during, 38.8% before Snack between breakfast and lunch: 25.8% during, 32.3% before Lunch: 13.7% during, 8.9% before Snack between lunch and dinner: 20.2% during, 28.7% before
Kansiime et al., 2021[40]	Meal Skipping	**M/I:** Food security: The food insecurity experience scale (FIES)[132] **M/I:** Skipped a meal **RO:** Yes/no	Meal skipping significantly increased in samples from Kenya (19% before, 42% during) and Uganda (12% before, 27% during). This was an indicator of food insecurity, which rose significantly in both samples.
Kaya et al., 2021[105]	Meal Skipping	**M/I:** Fear: The fear of COVID-19 Scale (FCV-19S)[148] **M/I:** Anxiety: The Generalized Anxiety Disorder-7 test (GAD-7)[149] **M/I:** Eating: Questions about skipping meals (not specified)	There was a significant decrease in skipping breakfast (19.9% before to 16.7% during) and snacks (54.7% before to 35.6% during) and a significant increase in skipping lunch (35.6% before to 49.2% during).

Khubchandani et al., 2020[93]	Overeating Restrictive Eating Meal Skipping	**M/I:** Stress: 10-item Perceived Stress Scale (PSS)[143] **M/I:** Dietary behaviors: Four questions about dietary behaviors (e.g., overeating, fasting, etc.) **RO:** More than before the pandemic/same as before the pandemic/less than before the pandemic	39% reported overeating at the same level 39% reported overeating more 22% reported overeating less 52% reported no changes in restricted eating 20% reported an increase in their restricted eating 28% reported a decrease in their restricted eating 45% reported no changes in meal skipping 25% reported skipping meals more 30% reported skipping meals less 54% reported no changes in fasting 16% reported increased fasting 30% reported less fasting Changes in overeating, restricted eating, meal skipping, and fasting were related to higher stress scores.
Phillipou et al., 2020[98]	Binge Eating Restrictive Eating	**M/I:** Current negative mood states (over the past week): The Depression Anxiety Stress Scale (DASS-21)[150] **M/I:** Restricted eating and binge eating questions adapted from the Eating Disorders Examination Questionnaire (EDE-Q)[151] **RO:** 5-point Likert scale ranging from 1- a lot more to 5-a lot less	60% reported no changes in binge eating behaviors 34.6% reported increased binge eating behaviors 5% reported decreased binge eating behaviors 59% reported no change in level of food restriction 27.6% reported a greater level of food restriction 13% reported less food restriction
Puhl et al., 2020[99]	Binge Eating	**M/I:** Binge eating: Two questions adapted from the Questionnaire on Eating and Weight Patterns-Revised[152] "In the past month, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you (binge-eating)?" and "During the times when you ate this way, did you feel you couldn't stop eating or control what or how much you were eating?" **RO:** yes/no **M/I:** Weight stigma[153]: asked how often they teased you about your weight (1 = Never, 2 = Less than once a year, 3 = A few times a	Those who experienced pre-pandemic weight stigma had 2.88 times higher odds of binge eating during the pandemic.

		year, 4 = A few times a month, and 5 = At least once a week)	
Robertson et al., 2021[101]	Uncontrolled Eating	**M/I:** Perceived changes in eating: "I have found it more difficult to regulate or control my eating"; "I have become more preoccupied with food/eating" **M/I:** Psychological distress: The 4-item version of the Patient Health Questionnaire (PHQ-4)[154]	29.4% of participants agreed and 23.7% strongly agreed that it was more difficult to control or regulate eating during the pandemic compared to before 37.8% of participants agreed and 21.8% strongly agreed they were more preoccupied with food and eating during the pandemic compared to before Both difficulty with controlling eating and preoccupation with food were significantly related to psychological distress.
Robinson et al., 2021[70]	Overeating Meal Skipping	**M/I:** 10 questions on mental/physical health: "Compared to before the COVID-19 lock-down in the UK, I have .... (e.g., 'Felt lonely', 'Had conflict/arguments with others')" **RO:** 7-point scale ranging from 1 = A lot less frequency to 7 = A lore more frequently **M/I:** The 5 item WHO well-being scale[155] **M/I:** Overeating: The Appetitive Drive subscale of the Addiction-Like Eating Behavior Scale[156]	Overeating during COVID-19 was associated with lower age and education, being female, higher BMI, having a previous psychiatric diagnosis, having had COVID, and experiencing negative mental health since lockdown 45% reported no change in meal skipping 23% reported increased meal skipping (12% a little more, 7% more, 4% a lot more). 31% reported decreased meal skipping (9% a little less, 11% less, 11% a lot less) 48% reported no change in fasting 19% reported increased fasting (8% a little more, 6% more, 5% a lot more). 33% reported decreased fasting (9% a little less, 12% less, 12% a lot less)
Robinson et al., 2020[96]	Binge Eating	**M/I:** Binge Eating: "Compared with before the COVID-19 virus crisis, I have binged on food." **RO:** 7-point scale from 1- a lot less to 7- a lot more. 1-3 was coded as reduced behavior, 4 was no change, and 5-7 were increased behavior	49% reported increased binging 33% of participants reported no changes in binging 19% reported decreased bingeing
Şimsek & Şen, 2020[100]	Uncontrolled Eating Restrictive Eating	**M/I:** Eating behaviors: 20 questions from the three-factor eating questionnaire[157]	There were significant increases in uncontrolled eating during the COVID-19 pandemic compared to before Participants with a lower income had greater uncontrolled eating compared to those with a higher income

		There was a significant decrease in cognitive restraint behavior during compared to before COVID-19 There was lower cognitive restraint and higher uncontrolled eating in participants aged 18-20 compared to those above 35.

[a] The response options stated here are quoted directly from Di Renzo, Gualtieri, Pivari, et al., 2020.[67] There was no reporting on the "Yes, I eat out of the meals" response option.
[b] As cited in Flaudias et al., 2020[97]

Table 10. Measures and Findings for Reasons for Changes in Eating During the Initial Months of the COVID-19 Pandemic

Citation	Reason	Measure/Items (M/I) & Response Options (RO)	Findings
Adams et al., 2020[103]	Food Insecurity	**M/I:** Whether/ how often they cut meal sizes or skipped meals in the past 30 days because there was not enough money for food[139] **RO:** Number of days/month ≥ 3 days considered food insecure	Food security lowered by 17% and there was a 20% increase in families with very low food security during the pandemic. There were increases in meal skipping related to lack of money from an average of 2.9 ± 2.2 days/month before the pandemic and 11.0 ± 7.5 during the pandemic.
Almandoz et al., 2020[89]	Stress Food Insecurity	**M/I:** Do you stress eat more? **RO:** Yes/No **M/I:** 6-item US Adult Food Security Survey Module[139]	61.2% reported stress eating 78.3% of the sample was not food insecure
Buckland et al., 2021[45]	Emotional Eating Craving	**M/I:** Food responsiveness, emotional eating: The Adult Eating Behavior questionnaire (AEBQ)[158] **M/I:** Cravings: The Control of Eating Questionnaire (CoEQ)[159]	Greater emotional overeating and lower emotional undereating were significantly associated with higher increased overall eating 46% of participants reported increased food cravings; 23% reporting less cravings 41% of participants reported no changes and 36% reported increases in craving intensity during COVID-19 compared to before Greater craving frequency and intensity and lower craving control were significantly associated with higher increased overall eating
Carroll et al., 2020[47]	Food Insecurity	**M/I:** "During the past month, was there a time when you were worried you would not be able to pay the mortgage, rent or other bills on time?" **RO:** Yes/no/I don't know **M/I:** "Are you worried about not being able to pay the mortgage, rent or other bills on time over the next 6 months?"	5% of fathers and 10% of mothers reported concerns about food security in the past month or over the next 6 months

Cheikh Ismail et al., 2020[66]	Weight Control Time	**M/I:** Meal skipping? **RO:** yes/no **M/I:** Main reasons for skipping meals? **RO:** to reduce food intake, lack of time, to lose weight, lack of appetite, fasting	People reported the main reason they skipped meals during and before the pandemic was: Losing weight (23.6% during, 18.5% before) Lack of time (30.6% during, 62.3% before)
Cheikh Ismail et al., 2021[65]	Weight Control Time	**M/I:** Meal skipping? **RO:** yes/no **M/I:** Main reasons for skipping meals? **RO:** to reduce food intake, lack of time, to lose weight, lack of appetite, fasting	People reported the main reason they skipped meals during and before the pandemic was: Losing weight (23.8% during, 20.2% before) Lack of time (27.0% during, 60.8% before)
Di Renzo, Gualtieri, Cinelli, et al., 2020[107]	Emotional eating Anxiety	**M/I:** Anxiety: 14 item Hamilton Anxiety Rating Scale[160] **M/I:** Depression: 17 item Hamilton Depression Scale[161] **M/I:** Emotional eating: 25 item Yale Food Addiction Scale (YFAS)[162]	57.8% of participants reported feeling anxious due to their eating habits 48.7% reported using food to respond to anxious feelings 55.1% reported increasing their food intake to feel better 20.3% reported exclusion of foods that led to anxious feelings
Elmacloğlu et al., 2021[102]	Emotional Eating	**M/I:** Uncontrolled eating, cognitive restriction, and emotional eating behavior: Eighteen items in total[140,141] **RO:** 1=absolutely true; 2=mostly true; 3=mostly false; and 4=absolutely false	In normal individuals, emotional eating behavior increased significantly during the pandemic compared to before Women's emotional eating scores were higher than men during the pandemic compared to before.
Flaudias et al., 2020[97]	Depression Anxiety Stress Body Image	**M/I:** Depression and Anxiety: The Hospital Anxiety and Depression Scale (HADS)[142] **M/I:** Perceived stress: The 10-item Perceived Stress Scale (PSS-10)[143] **M/I:** Eating behaviors: The body dissatisfaction and impulse regulation subscales of the Eating Disorder Inventory, 2nd edition (EDI-2)[144] an eating disorder screening tool (Sick,	Binge eating in the past 7 days was higher in those with higher BMI, perceived stress, stress related to lockdown, anxiety, and depression, those with probable eating disorders, and women Higher stress related to the lockdown and anxiety were associated with a higher likelihood of dietary restriction over the past 7 days. Higher endorsement of appearance ideals and body dissatisfaction ($p < 0.001$) associated with a higher likelihood of dietary restriction (past 7 days).

		Control, One, Fat, Food [SCOFF])[145] and the Ideal Body Stereotype Scale (IBSS)[146a]	Lower body dissatisfaction was related to increased intentions to binge eat in the coming 2 weeks (p<.001).
Haddad et al., 2020[104]	Anxiety Fear and Anger Boredom	**M/I:** The Eating Disorder Examination-Questionnaire (EDEQ)[147] **M/I:** 10 questions related to fear of COVID-19 (e.g., "Thinking about COVID-19 makes me feel anxious") **RO:** 5-point Likert scale ranging from 1 (not at all) to 5 (extremely) Higher scores indicate increased fear. **M/I:** Short boredom proneness scale (SBPS)[163] **M/I:** Lebanese anxiety scale (LAS)[164] **M/I:** Anger subscale of the Buss-Perry scale[165]	Greater anxiety, fear of COVID-19, anger, and boredom were significantly associated with higher eating concerns scores Greater fear of COVID-19 predicted higher restraint scores
Husain & Ashkanani, 2020[69]	Stress Anger Boredom	**M/I:** "Do you eat when you feel stressed, unhappy, angry, or bored?" Reported in reference to before and during the pandemic **RO:** Never/rarely/occasionally/ usually	Participants reported eating when stressed, unhappy, angry, or bored (before and during the pandemic): Never: 24.1% before and 23.6% during Rarely: 24.8% before and 21% during Occasionally: 35.9% before 34.5% during Usually 15.2% before and 21% during
Jeżewska-Zychowicz et al., 2020[108]	Stress Fear Food Access	**M/I:** "Have you noticed changes in the availability of food in stores over the last month?" **RO:** No, I did not notice any changes / yes **M/I:** Fear of limited access to food as the pandemic spreads **RO:** Definitely not/ rather not/ neither no nor yes/ rather yes/ definitely yes **M/I:** Perceived Stress Scale 4 (PSS-4)[143]	Higher levels of perceived stress were related greater fears of limited access to food and purchasing of larger quantities of food during the pandemic. 87.4% of respondents reported perceiving changes in food availability at the onset of the pandemic. 43.7% reported that they were "definitely" or "rather" not worried about limited food access as the pandemic spreads whereas 39% reported fears to some degree. Perceived changes in food availability were the strongest predictor of fear for limited food access.
Kansiime et al., 2021[40]	Food Security	**M/I:** Food security: The food insecurity experience scale (FIES)[132]	In the total sample, there were significant increases in food insecurity indicators including worrying about not having enough

			food, being unable to eat healthy/nutritious foods, eating only a few kinds of foods, skipping meals, eating less food, running out of food, feeling hungry and not eating, and going the whole day without eating. In the total sample here were significant increases in the amount of people who were food insecure (39% increase) and severely insecure (16% increase)
Kaya et al., 2021[105]	Anxiety Fear	**M/I:** Fear: The fear of COVID-19 Scale (FCV-19S)[148] **M/I:** Anxiety: The Generalized Anxiety Disorder-7 test (GAD-7)[149]	Anxiety was positively related to consumption of milk, cheese, kefir, meat, poultry, fish, legumes, dried fruits, nuts-seed, bread, rice-pasta, cake-cookies and general desserts. Fear of COVID was positively related to consumption of yoghurt, cheese, kefir, cake-cookies, dried fruit and nuts-seeds.
Khubchandani et al., 2020[93]	Stress	**M/I**: Stress: 10-item Perceived Stress Scale (PSS)[143] **M/I**: Dietary behaviors: Four questions about dietary behaviors (e.g., overeating, fasting, etc.) **RO**: More than before the pandemic/same as before the pandemic/less than before the pandemic	High stress scores were related to worsening diet and changes in restricted eating, fasting, skipping meals, and overeating. Stress scores were lowest among those that had no changes in these behaviors.
Marty et al., 2021[53]	Mood Weight Control	**M/I:** Food choice motives: French version of the Food Choice Questionnaire developed in English[166] and adapted[167]	48% of participants reported an increase in the importance of mood during COVID compared to before and this was associated with worsened dietary nutritional quality 29% of the participants reported an increase in importance of weight control and this was associated with lower dietary nutritional quality
Pakravan-Charvadeh et al., 2021[83]	Food Security	**M/I:** Food Security: modified version of the HFIAS,[168] validated in Iran RO: 9 scales rated over the past 4 weeks with response options including never/ rarely/ sometimes/ often with total scores ranging from 0-27. Higher scores indicate higher household food insecurity	There was a reduction in food insecurity overall p<.001 Food security was negatively related to factors such as higher family size, and number of educated family members. Food security was positively related to factors such as personal savings and nutrition knowledge.
Pellegrini et al., 2020[55]	Depression	**M/I:** "Which of the following conditions mainly impact on	Participants reported the following as mainly impacting their eating behaviors:

	Anxiety Boredom Family and Friends Time Exposure	your eating habits? (you can choose more than 1 option)"	34.7% reported anxiety/depression 36% of participants reported boredom 21.3% reported family presence 32.7% reported increased time for cooking 19.3% reported continuous availability of food
Poelman et al., 2021[56]	Stress Boredom Friends and family Time Exposure	**M/I:** Eating behavior reasons: Participants were asked to indicate the two most important reasons for eating either healthier or less healthy from a list	Percent of participants that reported the following relevant factors related to eating healthier during lockdown: 30.3% reported more time/ headspace to prepare a healthy meal 26.3% reported more time/head space to be conscious about healthy nutrition 30.3% reported a need to improve resistance 17.2% Facing less unhealthy temptations at work 25.3% Facing less unhealthy temptations at social events 24.2% Facing less unhealthy temptations when going out for dinner Percent of participants that reported the following relevant factors related to eating unhealthier during lockdown: 19.2% reported more stress 21.9% reported being bored 5.5% reported less social control 17.8% reported fewer social contacts/feeling lonely 5.5% reported more time/head space to prepare an extensive meal 19.2% reported more time/head space and opportunities to bake 31.5% reported more leisure time 35.6% reported facing more unhealthy temptations at home
Puhl et al., 2020[99]	Depression Stress	**M/I:** General weight teasing and weight stigma: assessed with a tool developed by the researchers to ask participants about the frequency they are teased about their weight **M/I:** Depressive symptoms: Six-item scale[169] **M/I & RO:** Perceived stress[170] Average level of stress was	Participants who experienced weight stigma and weight teasing prior to the COVID-19 pandemic reported greater depression, stress, and eating to cope during the pandemic.

		indicated in the past 30 days, with response options ranging from 1 (Not at all stressed) to 10 (Very stressed) **M/I:** Eating as a coping strategy: The five-item coping subscale of the Motivations to Eat Scale[171]	
Robertson et al., 2021[101]	Psychological Distress Cravings	**M/I:** Perceived changes in eating: "I have found it more difficult to regulate or control my eating"; "I have become more preoccupied with food/eating" **M/I:** Psychological distress: The 4-item version of the Patient Health Questionnaire (PHQ-4)[154]	Psychological distress was significantly related to difficulty in eating control and regulation ($p < 0.001$) Psychological distress was significantly related to preoccupations with food/eating ($p < 0.001$) where 37.8% "agreed" and 21.8% "strongly agreed"
Robinson et al., 2021[70]	Emotional Eating Time	**M/I:** 10 questions on mental/physical health: "Compared to before the COVID-19 lock-down in the UK, I have .... (e.g., 'Felt lonely', 'Had conflict/arguments with others')" **RO:** 7-point scale ranging from 1 = A lot less frequency to 7 = A lore more frequently **M/I:** The 5 item WHO well-being scale[155] **M/I:** Overeating: The Appetitive Drive subscale of the Addiction-Like Eating Behavior Scale[156]	42% of participants reported eating more due to their feelings 26% of participants reported eating less due to their feelings COVID mental health decline was significantly related to overeating 88% reported having time to eat healthily
Rolland et al., 2020[109]	Mental Well-being General Stress Family and friends	**M/I:** Warwick-Edinburgh Mental Well-being Scale (WEMWBS)[172] **M/I:** Stress visual numeric scale **M/I:** "How many people share your accommodation during the lockdown (including you)?"	Increased consumption of caloric/salty foods was related to lower mental well-being, higher general stress, and current/past psychiatric disorders. Increased consumption of caloric/salty foods was related to having a partner and being lockdown alone
Rossinot et al., 2020[95]	Depression Stress	**M/I** "Since the beginning of the lockdown, are you feeling more . . . anxious? Depressed? Irritable?"	Negative changes in nutrition were related to negative changes in mental health (depression, stress, irritability)

		RO:0-more depressed, stressed, irritable/ 3- no change. **M/I & RO:** "self-evaluation of the change during the lockdown of their diet (less balanced, no change, more balanced)"	
Scarmozzino & Visioli, 2020[59]	Anxiety	**M/I:** Measures are all in Italian and can be found through this link: https://clikka.net/0flBP	42.7% of participants reporting an increase in "comfort food" consumption reported it was due to higher anxiety levels
Şimsek & Şen, 2020[100]	Emotional Eating	**M/I:** Eating behaviors: 20 questions from the three-factor eating questionnaire[157]	Emotional eating significantly increased during compared to before the pandemic No significant differences in emotional eating by age
Zeigler et al., 2020[110]	Stress Boredom Cravings Family and friends Exposure	**M/I:** Eating: The Weight and Lifestyle Inventory (WALI)[173] **M/I:** Stress: The Perceived Stress Scale[174]	52% reported eating more in response to stress 73% reported eating more when bored 73% reported eating more due to craving certain foods 59% reported eating more often with friends and family 65% reported eating more in response to sight and smell of food

[a] As cited in Flaudias et al., 2020[97]

Figure 1. Flow Diagram of the Articles Included and Excluded from the Present Review of Changes in Adults' Eating Behaviors During the Initial Months of the COVID-19 Pandemic