Food-related experiences and behavioral responses among people affected by chemosensory dysfunctions following COVID-19: A scoping review

Nicklas Neuman | Pernilla Sandvik | Ninni Bellini Lindholm | Katharina Bömer-Schulte | Elin Lövestam

Abstract
A category of symptoms that became characteristic early in the first wave of the coronavirus disease 2019 (COVID-19) pandemic was chemosensory dysfunctions (alterations of smell and taste). Such symptoms substantially affect food and eating—cornerstones for both nutrition-related health outcomes and for quality of life. Based on this, this scoping review aimed to map out existing scientific literature on food-related experiences and related behavioral responses among people affected by chemosensory dysfunctions following COVID-19. A librarian-supported search of PsycInfo, PubMed, and Scopus for publications written in English (2020 to April 26, 2022) was conducted. Two authors searched for and screened publications and three others extracted and collated data. These are reported following the Preferred Reporting Items of Systematic reviews and Meta-Analyses extension for Scoping Reviews. Of 1169 hits, 9 publications were included in the review. The results are thematized as "Psychological and social aspects" and "Nutritional aspects," each with the subsections "Experiences" and "Behavioral responses." A great variety of food-related problems, nutritional and mental health effects, and implications for social life are identified. People affected by chemosensory dysfunctions following COVID-19 suffer, as evident both in stories from qualitative studies and in measurements of quality of life. The results impact all professions who are and may come to be involved in treating these patients, such as nurses, physicians, dietitians, and psychologists. With more knowledge about the dysfunctions’ manifestation, duration, and impact on everyday life, multiprofessional teams need to collaborate in supporting patients medically, psychosocially, and nutritionally.

KEYWORDS
commensality, COVID-19, nutrition, olfactory disorders, quality of life
1 | INTRODUCTION

The effects of coronavirus disease 2019 (COVID-19), caused by infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), vary greatly in their severity and can be both acute and long-lasting. Consequently, day-to-day activities will be affected in markedly different ways both during and after the disease. One category of symptoms that became characteristic early in the first wave of the pandemic was alterations of smell and taste (Gerkin et al., 2021; Parma et al., 2020; Vargas-Gandica et al., 2020); hereafter, “chemosensory dysfunctions.” A meta-analysis of studies published between January and June of 2020 estimated that taste dysfunctions, specifically, affected around half of those infected during spring 2020 (Sanasiaya et al., 2021). For chemosensory dysfunctions more broadly, estimates have been as high as around 70%–75%, although the prevalence varies greatly between studies (Hannum & Reed, 2021; Santos et al., 2021).

These symptoms have not only been highly prevalent, but also enduring. A systematic review found that, on average, anosmia and ageusia, complete loss of smell and taste, respectively, last for about 1–2 weeks (Santos et al., 2021). However, not having anosmia and ageusia does not mean that one is symptom free. One can still be troubled by more or less reduced (hyposmia, hypogeusia) or distorted (parosmia, dysgeusia) functions. Parosmia is triggered by external stimuli and may occur when receptor cells in the nose fail in detecting odors or transmitting them to the brain, something that also affects how flavor is perceived. One can also experience phantom smell or taste (phantosmia, phantogeusia), in which an odorant or a taste is perceived even though an identifiable stimulus is absent.

In Sweden, an analysis of 100 patients who were infected 18 months or more before being tested for chemosensory functions found that only 65 had recovered (Tognetti et al., 2022). In addition, in a prospective Italian study, 14 out of 168 patients still reported symptoms after 2 years (Boscolo-Rizzo et al., 2022). The share of symptoms reported to be “As bad as it can be” went from over 20% at baseline to basically disappearing at 8 weeks.

Although most people seem to improve in time, we still do not know if, for some, the dysfunctions can be permanent. In a systematic review with meta-analysis, it was estimated that about 5 percent of individuals may develop long-lasting problems (≥180 days), but the authors add that this might be an underestimate (Tan et al., 2022). Furthermore, patients with greater initial severity and nasal congestion had worse prognosis for smell recovery, and women were less likely than men to recover both their taste and smell. Such long-lasting dysfunctions could detrimentally impact health and well-being, for example, due to negative effects on food intake, social relations, and quality of life (Croy et al., 2014; Gary et al., 2022; Kershaw & Mattes, 2018; Nolden et al., 2019). As what and how we eat are cornerstones both for nutrition-related health outcomes and quality of life, it is relevant to explore the relationship between COVID-19-induced smell and taste-related dysfunctions and everyday eating.

1.1 | Chemosensory dysfunctions and eating in everyday life

Eating is a central human activity. Changes in smell and taste consequently disturb something that is done frequently and regularly. Long-lasting impairments of taste and smell could therefore, in theory, be directly harmful for nutrition-related health outcomes by affecting what and how much a person eats. In addition to this, eating is a focal activity of social life. Eating together, a practice often referred to as commensality, can contribute to a sense of social cohesion, to transmission of knowledge and values, and to the reinforcement of social identity (Jönsson et al., 2021). The loss or distortions of commensality as such, irrespective of the type of food being eaten, may therefore negatively impact peoples’ psychosocial quality of life.

Several studies have investigated self-reported problems and experiences among people with disease-related difficulties to eat that are not caused by COVID-19. In general, chemosensory dysfunctions are reported to disturb eating in several ways, mostly by decreasing the enjoyment of eating, but also by reducing appetite, affecting food-intake quantities (both more and less), and causing difficulties in cooking and detecting spoiled food (Croy et al., 2014). The intake of specific foods could also be disproportionally affected, while loss of flavor may be compensated by more fat, salt, and sugar, potentially making the diet less healthy (Hannum & Reed, 2021; Kershaw & Mattes, 2018).

A Spanish qualitative interview study with patients suffering from a variety of functional impairments related to eating (e.g., brain injury, spinal cord injury, and cancer) identified perceptions of what the authors called “culinary solitude,” due to the symptoms’ negative impacts on sociable eating (Cipriano-Crespo et al., 2022). Feelings of shame, grief, and loneliness were cited as reasons to avoid eating at social celebrations, visiting restaurants, or engaging in meal conversations. Moreover, a Swedish study with lung cancer patients, also based on qualitative interviews, found that changes in smell and taste specifically could affect food preparation negatively (e.g., if food smelled bad or one was unable to taste it) and create discomfort during shared meals (e.g., breaking the social norm of eating what is offered if it tasted bad) (Belqaid et al., 2018).

When it comes to how food-related experiences are affected by COVID-19-induced chemosensory dysfunctions, the literature is scarce (Hannum & Reed, 2021). Nor has the literature yet been systematically outlined, despite the possibility that experiences of chemosensory dysfunctions from COVID-19 may differ in important ways from diseases in which alterations in taste and smell are to be expected from the start. Loss or distortions of taste and smell after COVID-19 came as a surprise to many, there has been deep uncertainty about how long-lasting the symptoms can be, and we still do not know if, and if so, how, they can be treated effectively. There is also a great deal of uncertainty over what possible future pandemic waves may bring in terms of symptoms. Therefore, to identify key findings and important research gaps concerning the relationship between everyday eating and chemosensory dysfunctions following COVID-19, we conducted a scoping review.
2 | METHODS

2.1 | Aim

The aim of the study was to map out existing scientific literature on food-related experiences and related behavioral responses among people affected by chemosensory dysfunctions following COVID-19.

2.2 | Design

A scoping review is a systematic review study, but differs from what is conventionally called a systematic review in that the latter attempts to review the evidence for a narrow research question, such as the quality of evidence for a causal relationship between a nutritional exposure and a specific disease. Instead, scoping reviews ask broader questions concerning the whole scope of a research field, for example, to map out the types of available literature and evidence, and to identify relevant research gaps (Munn et al., 2018). As the method has become increasingly popular, it has also evolved substantially from its early development (Arksey & O'Malley, 2005; Levac et al., 2010). However, the evolution of scoping reviews is not mainly about the content of the process as such. Rather, this evolution is about development of agreed-upon standards to ensure rigor and reproducibility through updated guides and standardized protocols and recommendations (Peters et al., 2020; Pollock et al., 2021), as has already long existed for systematic reviews and meta-analyses. Here we present our findings following the “Preferred Reporting Items of Systematic reviews and Meta-Analyses extension for Scoping Reviews” (Tricco et al., 2018). Details of the procedure are described below. All authors have agreed on this procedure and the interpretation of the outcomes.

2.3 | Search methods

Key terms of relevance for the research aim were identified by NBL and KB-S through Swedish MeSH, a resource of medical terminology to help database searches (https://mesh.kb.ki.se/). From the MeSH terms, further synonyms were identified and added to the searches, as were synonyms identified in relevant scientific publications. Thereafter, the search terms were grouped into blocks (Table 1).

The validity of the blocks was tested by adding synonyms to searches and see if this yielded similar quantities of search results. The final selection of terms was made by NBL and KB-S with consultation from EL. The selection of databases was made with assistance from a librarian at a university campus for health and medical sciences. Through this consultation, three databases were chosen: PubMed, Scopus, and PsycInfo. The search included studies published during January 1, 2020—April 26, 2022 (Supporting Information: Table S1 exemplifies a search in Scopus). The outcome of this selection process is illustrated in the “Identification” stage of the flowchart (Figure 1).

2.4 | Eligibility criteria

Following current recommendations on rigorous and reproducible scoping reviews (Peters et al., 2020; Pollock et al., 2021; Tricco et al., 2018), studies were included based on Population, Concept, and Context. The population is individuals who have had COVID-19. The concept is their food-related experiences and related behavioral responses following chemosensory dysfunctions. The context is the whole world, as the pandemic is global. Specific criteria are listed below.

Inclusion:
- Food-related experiences, problems, behaviors, and/or strategies related to taste and/or smell alterations after COVID-19
- Original publications in peer-reviewed journals or on preprint servers
- Publications in English

Exclusion:
- Studies focused only on symptom prevalence
- Meta-analyses and review articles
- Studies published before 2020
- Co-morbidities after COVID-19 infection
- Animal studies

Under the supervision of EL, NBL and KB-S scanned hits for titles and abstracts. Unless it was obvious from information in the title or abstract that a publication should be excluded, the full text was read. Examples of exclusions based on title were articles about household transmission of SARS-CoV-2 (Afonso et al., 2022) and mechanisms of the virus and olfactory dysfunctions in zebrafish (Kraus et al., 2022). From the abstracts, two excluded examples concerned subjective evaluations of smell and taste dysfunctions in Spanish COVID-19 patients (Ninchritz-Becerra et al., 2021) and consumption of tiwul (a cassava-based dish) in an Indonesian village during the pandemic (Fitriana et al., 2021). Preprints were included in the search results, but were excluded for the review based on criteria or for being duplicates of publications included.

For full-lengths, a checklist was used, with questions about the following: Did the publication include a connection between taste and/or smell alterations and food-related experiences, problems, behavioral changes, and/or strategies? Were such connections reported in the results? Were such connections the focus of the publication? In this stage, selection often required careful distinctions. Whenever there was a disparity in the evaluations of NBL and KB-S, the disagreements were discussed until a consensus was reached. Examples of excluded articles were one about the effects on quality of life due to COVID-19-mediated loss of smell among Germans (Otte et al., 2023), excluded because no specifically food-related results were presented, and one Australian study about nutritional status among patients (De Groot & Vivanti, 2022), excluded as the article contained no experiences, problems, behaviors, and/or strategies related to food intake.
### Table 1

Search blocks with related search terms (and/or synonyms) and specific MeSH terms and subject terms for PubMed and PsycInfo.

<table>
<thead>
<tr>
<th>Search blocks</th>
<th>Block 1: COVID-19</th>
<th>Block 2: Smell and taste</th>
<th>Block 3: Food choice, meals, and quality of life</th>
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</thead>
<tbody>
<tr>
<td><strong>Search terms</strong></td>
<td>covid-19 OR sars-cov-2 OR &quot;covid&quot; OR corona</td>
<td>AND smell OR olfact* OR ageusia OR hyposmi* OR anosmi* OR parosmi* OR phantosmi* OR chemosensory OR chemestesis OR taste OR gustation OR trigeminal*</td>
<td>AND eating OR &quot;feeding behavior&quot; OR appetite OR meal* OR commensalit* OR nutrition OR food OR dinner* OR strateg* OR eat* OR &quot;quality of life&quot; OR &quot;life quality&quot;</td>
</tr>
</tbody>
</table>

**MeSH terms in PubMed**
- covid-19 OR sars-cov-2
- olfaction disorders
- taste disorder
- quality of life
- feeding behavior
- appetite
- meals
- food
- adaptation, psychological

**Subject terms in PsycInfo**
- covid-19
- taste disorders
- anosmia

**Excluded terms that are covered through the synonyms above**
- post covid
- long covid
- olfactory disorder
- smell disorder
- taste disorder
- chemosensory dysfunction
- food intake
- food choice
- health-related quality of life
- coping strategy
- coping strategies

**Note:** Each column represents each block of the search string and were combined with an AND.

**Abbreviation:** COVID-19, coronavirus disease 2019.

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**Figure 1**

Flowchart of the screening process.
2.5 | Search outcomes

The total number of articles were 1169 (Scopus, n = 787; PubMed, n = 361; PsycInfo, n = 21). All were entered into a reference software in which the total sample was cleared for duplicates. After this, 842 articles remained. 451 articles were then excluded based on the title and a further 342 based on the abstract. Of the remaining 49 articles for which full texts were reviewed, another 40 were excluded—resulting in a final search outcome of 9 publications (see Figure 1 for a flowchart).

2.6 | Data abstraction and synthesis

Information regarding the study aim(s), the sample characteristics, the sampling procedure, the study design, and main results (of relevance to our research aim) were extracted from the publications and collated by NN, PS, and EL (Table 2). Apart from data extraction, the content of the articles was analyzed and divided into two main themes, presented below.

3 | RESULTS

Included publications were based on both qualitative (n = 5) and quantitative (n = 4) methods, and on data collected from social media posts (n = 2), individual interviews (n = 2), focus group interviews (n = 1), and surveys (n = 4). Despite different methods, we classified all of them within health and medical sciences. The two main themes below are “Psychological and social aspects” and “Nutritional aspects,” each with the subsections “Experiences” and “Behavioral responses.” The latter refers to how experiences were handled by the participants, either as explicit coping strategies or as subtler re- focusing of everyday activities. Running through both themes is the issue of sensory-related experiences: it is through sensory alterations that everything from sociability to nutrition is affected.

3.1 | Psychological and social aspects

3.1.1 | Experiences

Here we report how eating as an activity was affected from a psychological and social point of view, and how this coincided with broader psychosocial impairments such as detrimental effects on quality of life. To begin with, in an online survey of 3111 French respondents (78% women), “Enjoy eating” and “Eat alone” were part of a 16-item questionnaire of quality of life among adult individuals classified as having “olfactory disorders” (Ferdenzi et al., 2021). Of all 16 items, 15 were affected, including enjoyment of eating (decreased) and the preference to eat alone (increased). Similarly, 84% of participants with anosmia, specifically, experienced reduced enjoyment of food in a survey by Saudi Arabian and Egyptian researchers (Elkholi et al., 2021). In a qualitative interview study from Denmark, furthermore, eating in company was affected and generally preferred over eating alone, although food-related pleasure was said to be negatively affected, transforming eating from a mental desire to “a bodily need for energy and nutrients” (Høier et al., 2021, p. 8).

The aspect of commensality, although not always formulated with that terminology, appeared in other studies as well. Data from the AbScent Covid-19 Smell and Taste Loss Facebook group revealed problems with participation in cooking or shared meals, detrimentally influencing their social life (Burges Watson et al., 2021). For example, joys and pleasures related to food and anticipation of food were reduced, as were food-related social interaction with significant others, such as the inability to cook for their family, having to leave the house when cooking took place. Boredom and loss from the inability to eat in company were reported, as well as problems with going out to eat, leading to missed-out social gatherings. In an international survey (n = 727; 45% UK, 41% USA, 2% Canada, 1% Spain, 1% Netherlands, 9% “Others”) with free-text responses, partly based on another Facebook group (AbScent Parosmia and Phantosmia Support), similar patterns emerged: parosmia negatively affected quality of life when participants could no longer eat out or socialize with friends as before (Parker et al., 2022). Moreover, qualitative interviews with 20 English individuals demonstrated, among other things, that not being able to smell the food being cooked made people lose their cooking interest (Turner & Rogers, 2022).

The effects of chemosensory dysfunction on overall quality of life were reported to be negative for about three out of four participants (Elkholi et al., 2021; Ferdenzi et al., 2021). This was further supported by qualitative findings. For example, Danish interview participants said that their sensory experiences affected both food perceptions and their overall quality of life (Høier et al., 2021), whereas English focus group discussants expressed experiences of anxiety and other “adverse effects on mental and emotional well-being” (Khatri, 2022, p. 5). Participants expressed despair, lack of hope, and difficulties to endure commensality. In the AbScent Covid-19 Smell and Taste Loss group, the food-related problems described above interacted with broader alterations in the “relationship to the self, the world and other people” (Burges Watson et al., 2021, p. 14). Similarly, in a thematic analysis of the AbScent Parosmia and Phantosmia Support, changes in smell were said to detrimentally affect both emotional and mental well-being, making participants feel sad, isolated, lonely, and scared—one participant even said that “it’s ruining my life” and another that “nobody believes you if you try to explain it” (Parker et al., 2021, p. 12).

3.1.2 | Behavioral responses

Several behaviors used to handle psychological and social consequences were reported. Commensality could contribute to shifting focus from the food to the joy of the social connections around meals (Høier et al., 2021; Turner & Rogers, 2022), an unexpected qualitative finding given the increased preference to eat alone reported by
<table>
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<tr>
<th>Publication</th>
<th>Aim(s)</th>
<th>Sample</th>
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<td>Burges et al. (2021)</td>
<td>To document the impact of post-Covid-19 alterations to taste and smell.</td>
<td>About 9000 users of the AbScent Covid-19 Smell and Taste Loss support group on Facebook, followed from March 24 to September 30, 2020. They were screened according to smell and taste alterations, not broader COVID-19 complications. Participants were primarily from the United Kingdom (43%) and the United States (26%), but also South Africa, Philippines, Sweden, Pakistan, India, France, Nigeria, the Netherlands, and more. Age and gender were not documented.</td>
<td>Self-selection by interested individuals, followed by screening in accordance with the project aims.</td>
<td>Thematic analysis of Facebook comments.</td>
<td>Three main themes were identified: “Making sense of altered experience: We are the research”; “Altered eating and its consequences”; “Altered relationship to the world.” Participants spoke of the different manifestations of their reduced or distorted taste and smell, how this affected what and how much they ate, with consequent effects on weight gain or loss, and a lack of interpersonal and professional explanations or support. They reported altered eating, appetite loss, loss of pleasure in eating and social engagement, altered intimacy, an altered relationship to self and others, and lack of support from their social circles and from healthcare.</td>
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<td>Chaaban et al. (2021)</td>
<td>To investigate the effect of COVID-19 on self-reported appetite, sensory perception, and/or food-related pleasure. Specifically, the acute and long-term effects of COVID-19 on (1) the desire for food, hunger, and satiety sensations; (2) perception of smell, taste, and flavor; and (3) meals and intake of food types.</td>
<td>102 Danes in the postacute phase of COVID-19, yet still suffering from long-term effects on appetite, sensory perception, and/or food-related pleasure. Age 19–69 years (mean 41 ± 12.9), 88 women and 14 men.</td>
<td>Several Danish COVID-19 groups on Facebook (two general COVID-19 information groups and one for COVID-19 patients suffering from long-term effects), as well as posts on Twitter and LinkedIn.</td>
<td>Online survey.</td>
<td>86% experienced decreased to highly decreased desire for food in the acute phase, and 76% reported a desire to eat “less often.” The same proportions were 57% and 53%, respectively, in the postacute phase. In the acute phase, changes were reported for sweet (91%), salty (89%), sour (86%), and bitter (87%) tastes. Respective numbers in the postacute phase were 49%, 47%, 53%, and 60%. Eating behavior, types of diets, and food preparation were also affected, generally more so in the acute than the postacute phase. Common strategies</td>
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<td>Elkholi et al. (2021)</td>
<td>Finally, to study common strategies to tackle potential changes in appetite and sensory perception.</td>
<td>487 Adult COVID-19 patients with anosmia. Average age 31.4 years (± 9.7), 370 women and 117 men.</td>
<td>Convenience sample. Questionnaire conveyed through e-mails, sharing in faculties’ official webpages, and social media (e.g., Facebook, WhatsApp, and Twitter).</td>
<td>Online survey, including open-ended questions.</td>
<td>involved acceptance, identifying every ingredient in a meal, focus more on senses that functioned well, eating spicy, and trying to eat healthy.</td>
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<td>Ferdenzi et al. (2021)</td>
<td>To investigate the impacts of smell loss in COVID-19 patients in relation to Quality of Life, and to assess the importance of olfaction before and after the loss of smell. In addition, to assess the impact of smell loss on psychological well-being and distress, and coping strategies used by COVID-19 patients with smell loss.</td>
<td>3111 French adults with olfactory dysfunction and a COVID-19 diagnose. Age 18–85 years (mean 40.5 ± 12.5), 78% women.</td>
<td>Convenience sample. The study was advertised nationally through different channels (authors’ professional and personal networks, audio-visual media communications, local health centers, and pharmacies). The call was directed online.</td>
<td>Online survey.</td>
<td>About three of four respondents reported a decreased quality of life. Negative effects were reported by around 73%, mostly concerning attentiveness to personal hygiene and interest in food and drinks. 85% reported a reduced ability to taste or enjoy food, 67% a decreased appetite. In open-ended questions, 23% reported a decreased interest in food and drink, 25% difficulties in cooking, and 15% problems with eating.</td>
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<td>Haier et al.</td>
<td>To investigate the subjective strategies for maintaining appetite applied by patients recovering from COVID-19.</td>
<td>19 Danes in the postacute phase of COVID-19, suffering from ageusia ($n = 14$), anosmia ($n = 13$), and parosmia ($n = 4$). Age 25–66 years (mean 44), 17 women and 2 men.</td>
<td>Recruitment via a Facebook group for people suffering from long-term effects of COVID-19.</td>
<td>Semistructured in-depth interviews.</td>
<td>Four key themes were identified: “A focus on well-functioning senses”; “A focus on familiar foods”; “A focus on the eating environment”; “A focus on postigestive well-being.” Alterations in taste and smell were common, as well as reduced enjoyment from eating, an increased preference to eat alone, and higher risk to burn meals and eating spoiled food. Younger participants reported eating rotten food more often than older, and displayed more variation in salting habits and eating pleasure.</td>
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<td>Khatri (2022)</td>
<td>To explore food consumption and subsequent behavioral changes amongst people suffering from postacute sequelae of COVID-19, associated with alterations in taste and smell.</td>
<td>Five focus groups with a total of 47 English individuals, suffering from ageusia (n = 16), parageusia (dysgeusia) (n = 7), phantogeusia (n = 18), anosmia (n = 9), hyposmia (n = 30), parosmia (n = 28), and phantosmia (n = 11). Ages 18–70 years, 20 women and 27 men.</td>
<td>Participants were invited over a 4-month period, via the Health and Life Sciences website and flyers with referrals from employees/students to individuals inclined to participate.</td>
<td>Focus group interviews.</td>
<td>Five themes were identified: “Occurrence and duration”; “Foods implicated and flavor intensity”; “Nutrient intake”; “Coping”; “Anxieties.” Taste and smell alterations were common. Many foods tasted unpleasantly, including protein-rich animal products, while low-pH foods, and highly processed foods, especially cold, were preferred. Changes in food affected weight, nutrition status, cooking, types of foods consumed, coping mechanisms, mental health (e.g., anxiety), social interactions, and family life.</td>
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<td>Parker et al. (2021)</td>
<td>To explore the symptoms and sequelae of postinfectious olfactory dysfunction syndrome, using unstructured and unsolicited threads from</td>
<td>137 Posts made in the AbScent Parosmia and Phantosmia Support closed group on Facebook (&gt;7000 users in total). Age and gender were not documented.</td>
<td>Posts made between June 12 and December 14, 2020, with a special focus on the topic “Can you all add here your worst foods for parosmia?”</td>
<td>Thematic analysis and content analysis of Facebook comments.</td>
<td>Seven themes were identified: “How it makes me feel”; “Fluctuations”; “Items that trigger parosmic experiences”; “Defining the character of parosmic distortions”; “The smell of feces”; “Phantosmia”; “Tips and tricks for survival.” Negative emotional and mental health impacts were described.</td>
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<td>Parker et al. (2022)</td>
<td>727 individuals from UK (n = 330), USA (n = 297), Canada (n = 15), Spain (n = 9), the Netherlands (n = 8), and &quot;Others&quot; (n = 68). They reported loss of smell only (n = 66), as well as mild (n = 194), moderate (n = 226), severe (n = 117) and very severe (requiring hospitalization) (n = 3) COVID-19. Age 18–75 years (mean 43), 651 women and 76 men.</td>
<td>Convenience sample. Recruitment was performed through &quot;Ear, nose, and throat&quot; clinics, Facebook (AbScent Parosmia and Phantosmia Support group and personal accounts), and Twitter, from June 19, 2020, to September 5, 2021.</td>
<td>Online survey.</td>
<td>A statistically significant correlation was found between strength of distorted odor and disgust. Most commonly, onion, meat, and coffee were perceived as smelling unpleasant while the smell of feces, for example, was perceived less disgusting. Overall, the symptoms had a negative effect on quality of life.</td>
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<td>Turner and Rogers (2022)</td>
<td>20 English individuals who all had experienced chemosensory loss associated with COVID-19. Age 21–68 years (mean 32.1 ± 14.3), 18 women and 2 men.</td>
<td>Recruitment via social media and snowball sampling.</td>
<td>Semistructured interviews.</td>
<td>Five themes were identified: &quot;Altered chemosensory perception;&quot; &quot;Appetite (and body weight);&quot; &quot;Altered food choices;&quot; &quot;Drinks;&quot; &quot;Eating rituals.&quot; Altered smell and gustation were common, as was decreased appetite. Changes in food choices...</td>
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Moreover, several strategies that came up did not have a direct connection to food, such as olfactory training (Chaaban et al., 2021; Ferdenzi et al., 2021). Another social response was community engagement and shared knowledge of social media (Burges Watson et al., 2021; Parker et al., 2022). One of the most common responses identified as a psychological consequence was trying to accept the situation as the “new normal” (Chaaban et al., 2021; Elkholi et al., 2021). For some of the interviewed Danes, the memory of how something used to taste also helped to appreciate food and a lowered expectation of the experience could prevent disappointment (Høier et al., 2021).

Another thing that seemed important in creating a taste experience was to mentally shift attention to senses that were still functioning. One could, for example, focus more on the texture of food, with crunchy textures often perceived positively and soft textures negatively (Burges Watson et al., 2021; Chaaban et al., 2021; Høier et al., 2021; Turner & Rogers, 2022). Of respondents to an online survey among adults in Denmark who had experienced alterations in sensory perception, appetite, and/or food-related pleasure subject to COVID-19 (n = 102), about a third focused more on texture than before (Chaaban et al., 2021). The same proportion placed a greater focus on the appearance of the food. Lastly, focus on the trigeminal sense was also reported, with strong spices claimed to produce sensory experiences that partially compensated the loss or reduction in chemosensory functions (Chaaban et al., 2021; Høier et al., 2021; Turner & Rogers, 2022).

### 3.2 Nutritional aspects

#### 3.2.1 Experiences

All included studies, except one (Elkholi et al., 2021), described a variety of impacts on the amount of food eaten due to the alterations in taste and smell. Anosmia negatively affected appetite, satiation, and satisfaction, and food intake was shown both to increase, decrease, and remain unchanged (Burges Watson et al., 2021; Chaaban et al., 2021; Parker et al., 2021; Turner & Rogers, 2022). With an inability to appreciate the food, the motivation to eat decreased, which, Danish participants described, resulted in reduced food intake (Høier et al., 2021). The smell of a meal being prepared may stimulate appetite, something that was said to be lost in anosmia (Turner & Rogers, 2022). Instead, physiological factors such as hunger became the main cue to eat. This also applied to respondents with parosmia and phantosmia, but to an even greater extent and with an even more limited food intake as a consequence (Burges Watson et al., 2021). Effects on body weight were also reported (Turner & Rogers, 2022), and some actually considered weight loss to be positive (Burges Watson et al., 2021). Among those experiencing increased food intake, some stated that they ate for the sake of eating (Turner & Rogers, 2022).

Moreover, a sense of dissatisfaction was discussed in the AbScent Covid-19 Smell and Taste Loss Facebook group, leading
some to eat more (Burges Watson et al., 2021). In the Danish survey, more than half (54%) of the participants reported feeling less satiated after a meal, and the desire to eat was reduced in 70% of those affected by parosmia, partly because it was difficult to find strategies to handle the repulsiveness of some foods (Chaaban et al., 2021). Further, the issue of feeling satiated but not satisfied was addressed by Høier et al. (2021). Some described a pursuit for sensory satisfaction, continuously leading them to expose themselves to food, while others believed that the lack of hedonic stimulation from food reduced the motivation to eat (Høier et al., 2021). As mentioned, parosmia can make some foods repulsive, experienced by some as substantially restricting the diet, with a consequent risk of malnutrition (including weight gain or loss) (Parker et al., 2021, 2022). Unpleasant odors also made it difficult to eat nutritiously and people experienced a concern about both physical and mental health as a consequence (Burges Watson et al., 2021; Khatri, 2022).

3.2.2 | Behavioral responses

In the Danish interview study, everyone with taste and smell alterations had changed their diet by excluding foods that tasted bad and switching to foods that were still appreciated (Høier et al., 2021). Bad or appreciated tastes could differ depending, among other things, on the type of taste and smell alteration the person suffered from. Food that still gave a taste experience was generally appreciated. For people suffering from parosmia, discussions in the AbScent Parosmia and Phantosmia Support revealed that bland foods tended to be preferred to avoid unpleasant smells (Parker et al., 2021). An increased intake of sweets, salty snacks, and other forms of less healthy foods were reported, as well as tastes such as sweet and salty, but also fatty, sour, and more spices (Chaaban et al., 2021; Ferdenzi et al., 2021; Khatri, 2022; Parker et al., 2021; Turner & Rogers, 2022). People with anosmia described highly processed food as the least offensive, because it still had some taste (Burges Watson et al., 2021). In parosmia, increased intakes of unhealthy foods or foods with neutral tastes (e.g., white bread and yogurt) were explained by the fact that they were the only foods that could be eaten (Khatri, 2022; Parker et al., 2021, 2022). This type of food could also be used as comfort or reward (Høier et al., 2021; Turner & Rogers, 2022).

An increased snacking resulted in a more irregular food intake and a decreased intake during the main meals (Burges Watson et al., 2021; Turner & Rogers, 2022). There were, however, several participants who preferred to focus on eating a healthy diet, finding pleasure in knowing that the healthy food made the body feel good. In those cases, taste was considered secondary (Burges Watson et al., 2021; Chaaban et al., 2021; Høier et al., 2021; Khatri, 2022; Turner & Rogers, 2022). With parosmia, a number of foods were reported to be avoided completely, because of unpleasant odors (Chaaban et al., 2021; Parker et al., 2021). Those affected found it difficult to develop strategies to avoid such smells, even though some examples given included rinsing the mouth or chewing gum before eating (Chaaban et al., 2021). In addition to avoiding foods and strong spices, the possibility of eating cold food was also mentioned because it emits less smells (Khatri, 2022). Other examples of strategies were to reduce the time that food is in the mouth, for example by choosing food that can be quickly swallowed or food in liquid form that can be consumed with a straw (Khatri, 2022; Parker et al., 2021).

Although coffee, onions, meat, and, in general, protein-rich foods were commonly reported as triggering parosmic experiences (i.e., stimulating distorted and often unpleasant smells) (Parker et al., 2021; Parker et al., 2022), some also found protein-rich alternatives that worked, such as Quorn and turkey, whereas others could not eat any high-protein foods. Consequently, a concern about malnutrition was expressed (Parker et al., 2021). Some also considered nutritional supplements to cope with insufficient nutritional intakes (Khatri, 2022). Lastly, when drinking was affected, qualitative smell alterations leading to unpleasant odors could lead to overall reductions of beverage intakes (Turner & Rogers, 2022). Those looking for an intoxicating effect of drinking alcohol talked about an increased intake, whereas those with flavor as motivation reported the opposite (Parker et al., 2021).

4 | DISCUSSION

This scoping review has mapped out scientific literature on food-related experiences and related behavioral responses among people affected by chemosensory dysfunctions following COVID-19. It is clear from the results that participants of the different studies suffer, which is evident both in their own stories and in measurements of how quality of life is affected (see also Liu et al., 2021). Behavioral responses vary, such as avoiding foods that taste or smell bad, changing foods, and seeking new textures or chemesthetic experiences. Some reported to eat healthier, others less healthy, some gained and some lost weight, some drank more alcohol and others less. Commensality is important for some, to experience a social connection despite bad experiences of the food, but some also report to prefer eating alone. Psychological coping involved acceptance that this is the new normal and seeking support online. Also, a lack of satisfaction is something we consider an important finding, meaning that even if one may be able to eat to satiation, there are still sensory pleasures left unfulfilled. These and other findings are summarized above (Table 2), and we now focus on what we consider relevant research gaps.

To begin with, the literature severely lacks systematic comparisons regarding food-related experiences and behavioral responses among those affected. One research gap that follows is in-depth qualitative explorations of specific groups, such as children and the oldest old—both completely absent in this review—or those who have experienced clinical treatment for their problems. However, this is also between groups of (primary) symptoms, duration, and severity. Moreover, large-scale, longitudinal data are urgently needed, to churn out how symptoms’ transformation over time connect to health behavior, quality of life, social relations, co-morbidities, and...
more. The Facebook discussions from March to September 2021 revealed some changes (Burges Watson et al., 2021), so there are attempts in qualitative studies on which hypotheses could form. Moreover, the quantitative surveys in this review are not only cross-sectional, but also based on convenience samples. It is very clear that this led to skewed samples in terms of gender, but in general this is a problem to make inferences from a whole population. The populations must therefore be identified and sampled, as is done in related studies using National Health and Nutrition Examination Survey data (Bernstein et al., 2021; Roxbury et al., 2021), so as to make large-scale quantitative studies reliable and valid.

Many people have suffered for years, with no improvement in sight. Healthcare professionals must recognize that this may be very long-lasting, perhaps lifelong. If so, both psychological and nutritional treatments may be required. The review demonstrates a plethora of mental and social coping strategies and nutritional behavioral responses, but these are the individuals’ own initiatives, sometimes with the help of the Internet. This potential for the Internet to be a source of information and support is a double-edged sword. The Internet can be a wonderful resource for help when healthcare resources are lacking, but also one of low-quality, perhaps even dangerous, information and advice. As such, there is a clinical research gap concerning how medical treatment can help this patient group in case of prolonged dysfunctions, but also a research gap concerning the sources of information and coping strategies adopted by those receiving no medical help. Such research calls for a breadth of approaches of caring sciences, public health, and social sciences.

This patient group is new and has rapidly become incredibly large. We still know very little about the causes, or why there is such massive variability in etiology, composition of symptoms, and duration. We do not have any strong evidence-based treatments, although olfactory training currently has the strongest support and is a clinical recommendation (Helman et al., 2022; Jafari & Holbrook, 2022). Furthermore, we are only scratching the surface of how the problems involved in these long-term chemosensory dysfunctions affect and will continue to affect the health and well-being of those afflicted. Nursing research and nurse-guided interventions are needed regarding the clinical treatment of these chemosensory dysfunctions—how to reduce symptoms as well as how to care for patients’ in their daily lives, that is, how to cope with their broader life situation. Beyond nursing, this is also of substantial clinical relevance to nursing, clinicians must learn about the everyday life struggles of the patients, and the results of the literature reviewed here is an important contribution.

4.1 Strengths and limitations

The main strength of this scoping review is its compliance with authoritative recommendations and standardized protocols developed to ensure rigor and reproducibility of scoping reviews (Munn et al., 2018; Peters et al., 2020; Tricco et al., 2018), including direct application to nursing research (Pollock et al., 2021). Moreover, the author group has broad scientific competence in nutrition and dietetics, healthcare research, sensory sciences, and social scientific research about food and health, experience in qualitative and quantitative methods, as well experience in performing scoping reviews (Björnwall et al., 2021).

The small number of included publications can be seen as a limitation, but has to be contextualized within the short time that research on the topic has been conducted (since spring 2020). A broadened search for everything about chemosensory dysfunctions related to COVID-19 would have meant a more comprehensive review in total (cf. Gary et al., 2022). However, the in-depth analysis of food-related experiences and related behavioral responses would have gone missing. A further possibility would have been to broaden the search to effects of the pandemic, including, for example, studies about how everyday eating and commensality are affected by the physical distancing imposed by restrictions (Bascuñan-Wiley et al., 2022; Ceccaldi et al., 2020; Fourat et al., 2021). This would, again, have resulted in a larger sample of publications, but the analysis would have inevitably become more social scientific and less applied to nursing and other healthcare professions. Lastly, an evidence grading of the included literature could have improved the rigor even more. We chose to map out only the available evidence and identify research gaps. In-depth quality assessments and evidence grading will be important in the future, however, as increasing numbers of high-quality studies are published.

5 CONCLUSION

It is clear from the present review that people affected by chemosensory dysfunctions following COVID-19 suffer, which is evident both in their own stories and in measurements of how quality of life is affected. A large variety of food-related problems are identified, such as foods that are more or less problematic, nutritional and mental health effects, and implications for social life. These are met with a plethora of mental and social coping strategies and nutritional behavioral responses, almost exclusively based on the individuals’ own initiatives—not initiated by healthcare professionals. The results impact all professions who are and may come to be involved in treating this patient group, such as nurses, physicians, dietitians, and psychologists. With more knowledge about the dysfunctions‘ manifestation, duration, and impact on everyday life, multiprofessional teams need to collaborate in supporting these patient groups medically, psychosocially, and nutritionally.

AUTHOR CONTRIBUTIONS

Nicklas Neuman: Conceptualization; data curation; formal analysis; validation; project administration; supervision; visualization; writing—original draft; writing—review & editing; Pernilla Sandvik: Conceptualization; data curation; formal analysis; validation; writing—review & editing; Ninni Bellini Lindholm: Conceptualization; investigation;
CONFLICT OF INTEREST STATEMENT
The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT
Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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REFERENCES


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