Clinical Nutrition Open Science 67 (2026) 100645

Contents lists available at ScienceDirect

Clinical Nutrition Open Science

journal homepage:
www.clinicalnutritionopenscience.com

Original Article

Oral sensory alterations and influence on food preferences and eating difficulties in oncology patients: A quantitative descriptive study

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ARTICLE INFO

Article history:
Received 24 October 2025
Accepted 4 March 2026
Available online 9 March 2026

Keywords:
Cancer
Oral symptoms
Eating behaviour
Sensory alteration
Somatosensation
Online survey

ABSTRACT

Purpose: Cancer and its treatments can cause significant oral complications, including sensory alterations and other oral symptoms. Consequently, these symptoms can affect patients' nutrition, health outcomes, and quality of life. The study aimed to characterise sensory alterations and oral symptoms in oncology patients and explore their relationship with food preferences and eating challenges.
Method: An online survey was distributed among diverse types of cancer patients and survivors ($n = 100$). It comprised questionnaires on sensory perception, oral symptoms, sensory-related food preference, and eating difficulties. Hierarchical clustering analysis was performed to explore the different sensory profiles of patients. Correlation analysis was performed to examine the relationship between sensory alterations and oral symptoms with eating difficulties.
Results: Clustering analysis suggested the presence of distinct sensory profile groups: no alteration (48%), increased perception

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https://doi.org/10.1016/j.nutos.2026.100645

(44%), and decreased perception (8%). These groups exhibited differences in their sensory-related food preference. Common oral symptoms included dry mouth (68%), tooth sensitivity (66%), and nausea (45%). Sensory alterations (somatosensory: $r = 0.54$, $P < 0.001$; chemosensory: $r = 0.48$, $P < 0.001$) and oral symptoms (food processing issues: $r = 0.55$, $P < 0.001$; discomfort in mouth: $r = 0.44$, $P < 0.001$) were correlated with eating difficulties.

Conclusion: This study addresses gaps in previous research by examining sensory alterations, including somatosensory dimensions and oral symptoms, in a heterogeneous cancer population. The findings highlight the complexity and variability of sensory alterations and identify relationships with food preferences and eating difficulties, supporting the potential value of incorporating sensory evaluation into future nutritional care strategies.

1. Introduction

Cancer and its treatments lead to a range of symptoms that significantly impact eating and drinking abilities [1]. Research has consistently shown the negative impact of these symptoms on food intake and nutritional status of cancer patients [2–4]. Different strategies have been sought to increase food intake in patients at nutritional risk. These include the use of pharmacological interventions (e.g. appetite stimulants, cytokine modulators, and anabolic agents). These approaches may overlook the sensory perceptions of patients with cancer, a crucial but often underappreciated factor influencing food intake [5]. Dietary interventions such as energy and protein-rich diets, oral nutritional supplements, and personalised dietary counselling still face challenges due to the complexity and the multifactorial nature of the eating experience [6,7]. Despite these challenges, ongoing research continues to explore dietary solutions that better address the specific nutritional and sensory needs of this population.

Sensory alterations, including changes in taste (gustation) and smell (olfaction), have been widely reported in patients with cancer, with prevalence rates ranging between 20-100% [8–10]. Sensory alteration plays a crucial role in patients' eating behaviour, which is a multifaceted concept that encompasses various aspects of eating that shape individuals' nutritional decisions. This may include food preferences and aversions, food intake (quality and quantity), and the overall eating experience [11].

Despite this, much of the literature remains narrowly focused on taste and smell, while other sensory modalities, particularly somatosensation (e.g., texture, temperature, and chemesthetic perceptions like spiciness or cooling), have been relatively underexplored [12]. This modality is mediated largely by trigeminal pathways, which can be affected by cancer treatments such as chemotherapy and radiotherapy, especially in head and neck cancer, where radiation exposure can alter temperature perception, oral pain sensitivity, and chemesthetic responsiveness [13–17].

Somatosensation has been explored in head and neck cancers [13–17]. These studies suggest that cancer treatments may disrupt trigeminal function, altering texture discrimination, thermal sensitivity, or chemesthetic responses. However, the extent, nature, and variability of these changes across different cancer types remain poorly understood. Addressing this gap is essential, particularly given the documented heterogeneity in sensory alterations across cancer diagnoses, treatments, treatment intensity, and treatment stage [8]. Importantly, sensory perception does not operate in isolation. Oral symptoms such as mucosal pain, inflammation, or mouth dryness may interact with sensory alterations by modifying trigeminal input, amplifying discomfort, or distorting flavour perception.

Understanding how sensory alterations and oral symptoms intersect is, therefore, necessary for capturing the full complexity of cancer-related eating difficulties. Therefore, this study aimed to characterise sensory alterations (taste, smell, and somatosensation) and oral symptoms across diverse cancer types using a patient-reported questionnaire. Further, the study examined whether sensory alterations and oral symptoms were associated with food preferences and perceived eating difficulties. These insights will support the development of more patient-centred nutritional strategies that better reflect the complexity of sensory and oral changes affecting eating.

2. Materials and methods

2.1. Study design

This cross-sectional study was conducted between July 2022 and July 2023 using an online survey across France, Denmark, and the United Kingdom. Data were collected anonymously and in accordance with the General Data Protection Regulation via an online platform, Qualtrics (Provo, US). The survey was available in French, English, and Danish. The survey took 20–30 minutes to complete. While no technical restriction was applied to prevent multiple submissions by the same participant, responses were checked for duplicates by examining similarities in responses and verifying the consistency of reported language and country of residence. The study design was approved by the Research Ethics Committees of the respective countries (University of Lyon, France, ref: 2022-04-19-002; University of Reading, UK SREC 68/2022; University of Copenhagen, Denmark, CASE: 504-0326/22-5000). Patients could access the survey through the anonymous online link, where they were first presented with the study information sheet, and informed consent was obtained before initiating the survey. The present study is reported in accordance with the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) guidelines (Supplementary material S1).

2.2. Sample characteristics

Patients with cancer and cancer survivors were eligible to participate. The inclusion criteria were: 1) individuals aged 18 or over; 2) had been diagnosed with cancer; and 3) had received cancer treatment between 3 months and 5 years ago. No restrictions were applied regarding cancer type, stage, or current treatment status. Patients were recruited using convenience sampling through online newsletters, mailing lists, social networks of cancer organisations, cancer support groups, and Facebook pages. The sample was over-represented by females living with and beyond breast cancer. This broad approach enabled exploration across diverse cancer experiences and captured both short- and longer-term sensory alterations following cancer treatment.

2.3. Data collection methods

The survey included several questionnaires, including questions on sociodemographic (sex, age, country of residence), self-reported clinical information (cancer localisation, types of treatment received, and duration since treatment), sensory perception and preference, oral symptoms, and eating difficulty. Questions on sensory perception and preference, oral symptoms, and eating difficulty were adapted from published studies [2,18–22]. The compiled questionnaires (Supplementary material S2) were previously tested in a clinical study with patients with head and neck cancer [17], supporting their feasibility and preliminary applicability in the cancer population. Psychometric evaluation was performed for the sensory perception and oral symptoms questionnaires, including internal consistency assessment and exploratory factor analysis (Supplementary material S3). The sensory perception questionnaire showed acceptable internal consistency (Cronbach's $\alpha = 0.837$) with adequate sampling adequacy for factor analysis (KMO = 0.75), explaining 42% of the variance. The oral symptoms questionnaire demonstrated excellent reliability ($\alpha = 0.922$), strong sampling adequacy (KMO = 0.88), and explained 55% of the variance.

The questionnaire was reviewed and refined by native French, English, and Danish speakers with sensory science expertise and cancer research experience to ensure linguistic clarity and cultural appropriateness. Sensory perception and food preference were assessed using patient-reported comparisons to pre-treatment experiences, as baseline sensory data are unavailable. Briefly, the questionnaires were as follows:

1) **Sensory perception**: The questionnaire started with a general question on taste: "I notice changes in the taste of food/drinks" with response options ranging from "strongly disagree" to "strongly agree". This was followed by the individual evaluation of the different sensory modalities: "Compared to the situation before cancer treatment, I perceive that my *sensitivity* towards [salty/sweet/sour/bitter/smell of/texture of/cold/hot/pungent/cooling/astringent/carbonated drinks/alcoholic] product has …" with response options: "has decreased/remains unchanged/has increased", except for texture in which the response options were "changed/remains unchanged". In addition, they were asked to indicate the intensity of their change with response options: "0 = no change, 1 = insignificant, 2 = mild, 3 = moderate, 4 = severe".
2) **Oral symptoms**: Nineteen oral symptoms with options ranging from "1 = Never" to "5 = Always".
3) **Sensory-related food preference:** Ten questions were phrased as follows: "In comparison with the situation before cancer treatment, my *preference* for [salty/sweet/sour/bitter/pungent/cooling/astringent/carbonated drinks/alcoholic/texture of] product has …". The response options were "has decreased/remains unchanged/has increased", except for texture, in which the response options were "changed/remains unchanged".
4) **Eating difficulty**: Fourteen statements related to eating behaviour with response options of "1= disagree completely" to "6= agree completely". The statements included negatively connotated items (e.g. '*I have less appetite'; 'I eat smaller portions'; 'I have started to strongly dislike or avoid certain foods'; 'I lost the pleasure of eating'; 'Eating becomes demanding/effortful*') and positively connotated items ('*When I see or smell food that I like, it makes me want to eat*'; '*I like to eat a variety of food*'; '*I like to discover new food*'; '*I eat more frequently*').

2.4. Data analysis

Descriptive statistics were used to describe the sociodemographic and clinical information. Clustering analysis was performed on patients' responses to their sensory perception to explore the different sensory profiles of patients, using Ward's method and Euclidean distance. The optimal number of clusters was determined by inspection of the dendrogram, evaluation of agglomeration coefficients using the elbow method, and interpretability. Heatmap was visualised using R studio with *pheatmap* package [23]. Group comparisons used a t-test or a chi-square test, with assumptions of normality and homogeneity of variance assessed. A *P*-value of ≤ 0.05 was considered significant. The increased ($n = 48$) and decreased ($n = 8$) perception groups were combined into a single "alteration group" for comparisons due to the small size of the decreased perception group, which limited the statistical power for separate analyses. To evaluate the adequacy of the sample size for correlation analyses, a sensitivity power analysis was conducted using G*Power 3.1. With a sample size of $n = 100$ and $\alpha = 0.05$, the study had 80% power to detect correlation coefficients of approximately $r \geq 0.27$. This indicates that the study was sufficiently powered to detect moderate effect sizes.

Exploratory factor analysis (principal axis factoring with Promax rotation) identified underlying dimensions of sensory perception and oral symptoms. Factors were retained based on eigenvalues >1, scree plot inspection, and interpretability; items with loadings $\geq$0.40 were included. The sensory perception was divided into two factors based on the analysis: somatosensory score (mean intensity of changes in texture, temperature, and chemesthesis) and chemosensory score (mean intensity of changes across smell and basic tastes: sweet, sour, bitter, and salty), whereas oral symptoms were divided into three factors: 1) food processing issues (chewing difficulty, swallowing difficulty, food sticking in the mouth, food sticking in the throat, fear of eating due to pain, dry mouth, sticky saliva, throat pain, limited jaw opening); 2) problems with teeth and gums (gum pain, dental pain, avoiding certain foods due to dental problems, bleeding gums, and sensitive teeth, and mucositis); and 3) discomfort in mouth (lip pain, mouth pain, burning sensation in the mouth, and nausea)

(Supplementary material S3). Higher scores indicated more severe sensory alterations or more frequent symptoms. An eating difficulty score was calculated by averaging the scores of 14 individual items from the eating difficulty questionnaire. Positively connotated items were reverse scored, so higher scores indicate greater difficulties in eating. Spearman's rho coefficient was calculated to explore the associations between these scores.

3. Results

3.1. Characteristics of the study population

In total, 117 patients participated in the survey, with 100 patients completing it. The data used in the analysis were based on the complete responses. The sociodemographic and clinical characteristics of patients are presented in Table 1. Most of the respondents were female (81%) and had been diagnosed with breast cancer (49%), reflecting a demographic imbalance that may limit the generalisability of the findings to other cancer types and male patients. The respondents were mainly from France (60%), followed by the UK (28%), and Denmark (12%). The majority (87%) of patients received a combination of different treatments, with 90% receiving systemic treatment, 81% surgery, and 64% radiotherapy, respectively. Fifty-three per cent of the patients responded to the survey less than one year after their treatment, including eleven patients who were still undergoing treatment.

Table 1
Demographic and clinical characteristics of all patients and patients' classification based on their sensory perception. Data are presented as percentages (%) unless otherwise stated

Sociodemographic & clinical characteristics	All patients ($n = 100$)	Sensory alterations group[a]		
		Alteration group ($n = 52$)	No alteration ($n = 48$)	*P*-value
Age (years)	55.9 ± 11.1	58.1 ± 11.9	53.6 ± 9.8	0.041
Sex				0.752
Female	81	41	40	
Male	19	11	8	
Country				0.074
France	60	26	34	
UK	28	17	11	
Denmark	12	9	3	
Cancer localisation[b]				
Breast	49	19	30	
Bladder	3	2	1	
Colon	6	2	4	
Oesophagus	3	1	2	
Ovary	4	3	1	
Prostate	6	2	4	
Head and neck	12	11	1	
Other	17	12	5	
Types of treatment				
Surgery	81	39	42	0.181
Radiotherapy	64	32	32	0.745
Chemotherapy	82	41	41	0.553
Other treatments	46	22	24	0.569
Duration since treatment				
< 1 year ago	53	27	26	0.981
>1 year ago	47	25	22	

[a] The increased ($n = 48$) and decreased ($n = 8$) perception groups were merged into a single category of "alteration group" for statistical comparison, using chi-square test and independent t-test.
[b] No statistical comparison was performed for cancer localisation due to low expected cell counts in some cells.

3.2. Relationship between sensory perception and food preference

3.2.1. Prevalence of sensory alterations

Smell changes were reported by 29% of the respondents, with a roughly equal proportion of those reporting increased and decreased perception (Figure 1). Taste changes were experienced by approximately 30% of the participants across the four basic tastes. Among them, 20% reported increased perception of sour and bitter tastes, while the remaining 10% reported decreased perception. For salty and sweet tastes, a similar proportion of patients experienced both increased and decreased perception.

Thirty-four percent of the patients reported experiencing changes in their perception of food texture. Regarding chemesthetic sensations, 33–48% of patients reported changes, with 25–34% reporting increased as opposed to the smaller proportion of patients (8–14%) reporting decreased perception. Additionally, 26% and 34% of patients experienced altered perceptions towards cold and hot food/drink, respectively, with the majority reporting increased (23–29%) and only 3–5% reporting decreased perception.

3.2.2. Patient clustering based on sensory perception

Following the responses on their sensory perception, hierarchical clustering analysis suggested three distinct sensory profiles of patients (Figure 2): 1) patients with generally increased perception ($n = 44$), hereafter referred to as *increased perception* group; 2) patients with generally decreased perception ($n = 8$), hereafter referred to as *decreased perception* group; and 3) patients who did not perceive alterations or perceived mild alterations across the different sensory modalities ($n = 48$), hereafter referred to as *no alteration* group. Given the relatively small distribution of patients across the categories, the increased and decreased perception groups were merged into a single category for statistical comparison ("alteration group" in Table 1). The alteration and no alteration groups differed in age ($P = 0.041$), with relatively older patients categorised in the alteration group. Most of the patients with breast cancer were categorised in the no alteration group, whereas most of the patients with head and neck cancer were in the alteration group. Other variables, including sex ($P = 0.752$), country ($P = 0.074$), surgery ($P = 0.181$), radiotherapy ($P = 0.745$), chemotherapy ($P = 0.553$), other treatment ($P = 0.569$), and duration since treatment ($P = 0.981$), did not significantly differ between groups.

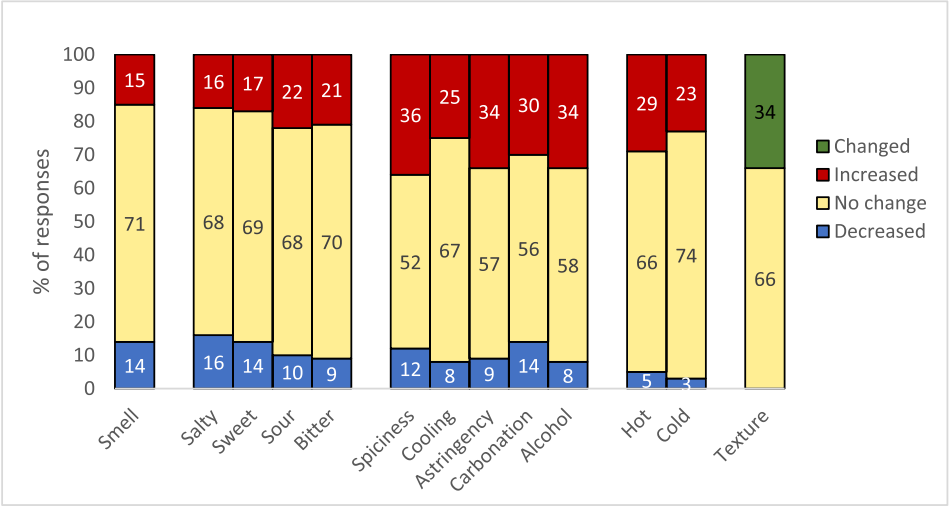

Figure 1. Change in the sensory perception of patients. Data are presented as percentages (%).
"In comparison with the situation before cancer treatment, I perceive that my sensitivity towards [sensory modality] food/drink has …"

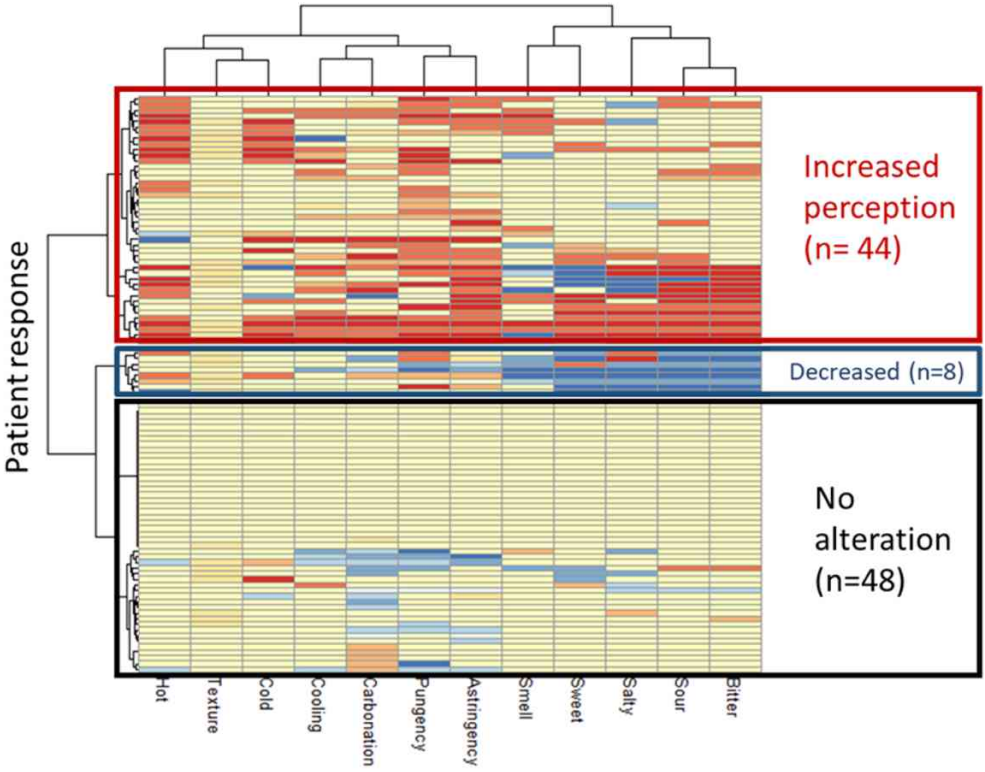

Figure 2. Heat-map diagram of a two-way hierarchical clustering analysis on the sensory perception of cancer patients.
Each row represents a patient, and each column represents their perception of each sensory modality. Red colour represents increased perception, yellow colour represents unchanged perception, and blue colour represents decreased perception. The colour saturation represents the intensity of the change in perception. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

3.2.3. Change in sensory-related food preference

Differences in sensory-related food preferences between groups are presented descriptively (Figure 3), as the small and uneven group sizes limited the statistical power for formal comparisons. Trends observed suggest that sensory alterations may influence food preferences. Considering all patients (Figure 3a), a notable percentage of patients reported a change in preference for sweet food (63%), with a relatively equal proportion of increased (29%) and decreased (34%) preference. Forty-nine per cent of the patients reported a changed preference for salty food, predominantly leaning towards increased preference (34%). Conversely, most patients who reported a changed preference for sour and bitter food showed a decreased preference (33 and 36%, respectively). Changes in preference for food texture were reported by 27% of patients. Regarding chemesthetic sensations, 42–55% of the patients reported changes in their preference for spicy, astringent, and carbonated products. Among them, approximately 40% reported a decreased preference for these products. None reported increased preference for alcoholic drinks, while 55% reported decreased preference.

When data are presented based on the sensory perception group (Figure 3b), most patients in the no alteration group reported no changes in preference. In contrast, the majority of the patients in the increased perception group reported a decreased preference for multiple sensory modalities (sour, bitter, spicy, astringent, carbonation, and alcohol). An increased preference for salty food was observed in the decreased perception group. This suggests a potential pattern between sensory perception and corresponding food preferences.

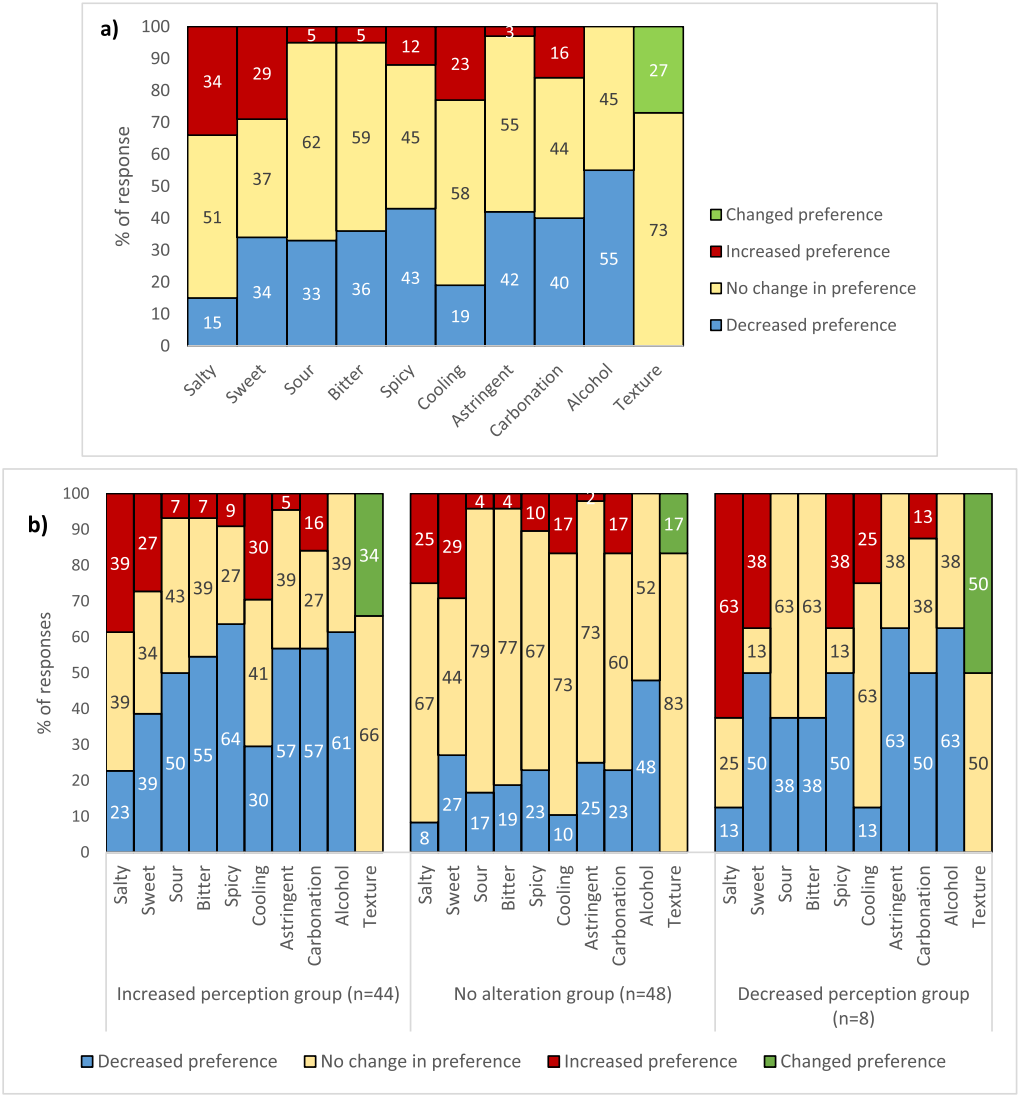

Figure 3. Change in sensory-related food preference of **a)** all patients and **b)** patients classified based on their sensory perception. Data are presented as percentages (%).

3.3. *Oral symptoms*

The most frequently experienced oral symptoms were dry mouth, sensitive teeth, nausea, mouth soreness, and gum pain (Table 2). More than half of the respondents experienced dry mouth and sensitive teeth.

3.4. *Associating sensory perception and oral symptoms with eating difficulty*

The correlation analysis revealed positive, significant associations between eating difficulty, sensory alterations, and oral symptoms (**Supplementary materials S4**). Greater difficulties in eating were observed with more severe sensory alterations and frequent oral symptoms. In descending

Table 2
Frequency of oral symptoms experienced by patients ($n = 100$). Data are presented as percentages (%)

Oral symptoms	Never	Rarely	Sometimes	Often	Always	Subtotal[a]
Dry mouth	16	16	35	22	11	68
Sensitive teeth	20	14	28	22	16	66
Nausea	30	25	30	12	3	45
Mucositis	27	31	28	12	2	42
Gum pain	30	29	31	8	2	41
Dental pain	34	28	26	10	2	38
Chewing difficulty	42	22	15	6	15	36
Food stuck in the mouth	43	22	18	13	4	35
Bleeding gum	36	30	24	7	3	34
Sticky saliva	46	21	20	7	6	33
Mouth pain	47	23	18	8	4	30
Avoid certain foods due to dental problems	50	21	15	5	9	29
Swallowing difficulty	48	23	15	10	4	29
Burning sensation in the mouth	61	13	20	5	1	26
Food stuck in the throat	56	19	14	9	2	25
Throat pain	51	24	17	6	2	25
Fear of eating due to pain	64	16	13	5	2	20
Lip pain	54	26	13	7	0	20
Limited jaw opening	73	13	7	3	4	14

[a] Sum of sometimes, often, and always (%).

order, eating difficulty demonstrated a moderate correlation with food processing issues ($r = 0.55$, $P < 0.001$), somatosensory alterations ($r = 0.54$, $P < 0.001$), chemosensory alterations ($r = 0.48$, $P < 0.001$), and discomfort in the mouth ($r = 0.44$, $P < 0.001$). A weak correlation with discomfort in teeth/gum ($r = 0.15$, $P < 0.001$) was observed. Further, some groups of oral symptoms were positively correlated with sensory alterations. Issues with food processing and discomfort in the mouth were positively correlated with somatosensory ($r = 0.55$, $P < 0.001$ and $r = 0.42$, $P < 0.001$, respectively) and chemosensory ($r = 0.48$, $P < 0.001$ and $r = 0.46$, $P < 0.001$, respectively) alterations. Whereas discomfort in teeth/gum was only weakly correlated with somatosensory alterations ($r = 0.30$, $P < 0.001$) and chemosensory ($r = 0.17$, $P < 0.001$) alterations.

4. Discussion

4.1. Main findings: sensory alterations and oral symptoms among various cancer patients

Hierarchical clustering analysis suggested the presence of three distinct profiles based on self-reported sensory perception: individuals reporting no sensory alterations (48%), increased perception (44%), and decreased perception (8%). These profiles should be interpreted as exploratory groupings rather than definitive clinical subtypes. Previous studies using self-reported sensory alterations have typically categorised patients based on binary approach of normal vs. altered perception, with less emphasis on the quantitative changes, such as increased (hypersensitivity) and decreased (hyposensitivity) perceptions [24]. Patients with hypersensitivity may find certain flavours or textures aversive, requiring softer, milder, or cooler foods, whereas those with hyposensitivity may need more intense flavours or textures to maintain appetite and food intake. Recognising both hypersensitivity and hyposensitivity is therefore critical for tailoring dietary interventions and optimising nutritional care in cancer patients.

Quantitative sensory alterations in cancer patients are often thought to involve mostly a hyposensitivity [25,26], yet our findings indicate that hypersensitivity can be prevalent, and both remain clinically significant. Reports of hypersensitivity have primarily been based on sensory tests or qualitative observations, with very few studies documenting it through self-reported questionnaires [13,15,19]. Furthermore, our study highlights that sensory alterations in cancer are not uniformly one-directional. Some patients exhibited heightened perception in certain sensory modalities while simultaneously experiencing diminished perception in others, with varying intensities across different sensory domains. These findings underscore the complexity and variability of sensory

perception in patients with cancer and warrant further research to better understand its underlying mechanisms and inform targeted dietary strategies.

Roughly half of the patients who completed the survey reported altered sensory perception across the different sensory modalities (30–32% for basic tastes, 29% for smell, 34% for texture, 33–48% for chemesthesis, and 26–34% for temperature). An existing review on the prevalence of sensory alteration among various cancers indicates significant heterogeneity, with taste changes reported in 20–70% of patients and smell changes in 16–49% [8]. For example, 60% and 26% of patients ($n = 50$, various cancers) reported taste and smell alterations, respectively [19], while in another study ($n = 151$, various cancers) the prevalence of sensory alterations ranged from 25–44% for basic tastes, 20% for smell, and 20–35% for temperature [20]. Variations in the prevalence may be attributed to differences in the clinical characteristics, such as age, cancer type, treatment modality, duration since treatment, and concurrent medications [27,28]. In the present study, the alteration group tended to be older, and ageing is generally associated with a decline in sensory acuity [29,30]. This may partially contribute to the observed sensory alterations and oral symptoms in this group, which could be linked to eating difficulties and food preference patterns.

A positive association between oral symptoms and sensory alterations was observed. Existing literature suggests that reduced saliva can influence sensory perception by affecting the interaction between tastants and food texture [31]. Additionally, oral pain and food processing difficulties may further alter the perception of specific textures or chemesthetic irritants in food. The most common oral symptoms reported by patients were dry mouth (68%), sensitive teeth (66%), nausea (45%), mucositis (42%), and gum pain (41%). In a study with patients with various cancers ($n = 139$), the prevalence was relatively lower: dry mouth (44%), nausea (32%), thick saliva (25%), sore mouth (22%), chewing difficulty (12%), and swallowing difficulty (17%) [32]. However, the prevalence was significantly higher in a study among patients with head and neck cancer ($n = 169$): dry mouth (92%), dysphagia (79%), mucositis (74%), and nausea (45%), likely attributable to radiotherapy targeting the head and neck region [4].

4.2. Food preferences and eating difficulties

Over 40% of the patients reported changes in their food preferences across the different sensory modalities. A notable increase was observed in the preference for salty foods over sweet ones, consistent with prior research [33]. Subsequently, the relationship between sensory perception and sensory-related food preferences was explored. Patients in the increased perception group displayed a tendency towards decreased preference for several sensory modalities, and those with decreased perception displayed increased preference for salty food. In contrast, the majority in the no-alteration group reported no change in preference (Figure 3b). Previous research on cancer observed that patients with taste alterations exhibited greater discrimination in their preference for oral nutritional supplement flavours compared to patients without taste alterations [19]. Food preferences can evolve during cancer treatments and are influenced by age, gender, cancer types, and the type of treatments [34,35].

The correlation analysis revealed positive, significant associations between eating difficulties, sensory alterations, and oral symptoms, although these do not imply causation. Frequent oral symptoms and severe sensory alterations were associated with increased eating difficulties. Particularly, eating difficulty was most correlated to somatosensory alterations and issues with food processing ($r > 0.5$), followed by chemosensory alterations. Issues with food processing included symptoms related to the ability to consume food with difficult textures, such as chewing and swallowing difficulties, food sticking in the mouth and throat, avoiding certain foods due to dental problems, limited jaw opening, dry mouth, and sticky saliva. Previous studies demonstrated that oral symptoms were strongly associated with a negative impact on health outcomes, such as lower nutritional intake and weight loss, in patients with head and neck cancer [3,4,36]. This suggests the importance of considering not only taste and smell (chemosensory) but also somatosensory and oral conditions when adapting food for patients with oral sensory alterations.

4.3. Methodological considerations

While this study provides novel insights into sensory alterations and eating challenges experienced by patients and survivors, some methodological considerations should be acknowledged. The cross-sectional design precludes causal inference. The use of an open, web-based survey may have influenced the composition of the study population and thus limits generalisability. The sample was modest, diverse, and primarily composed of individuals with breast cancer. Although a sensitivity analysis indicated adequate power to detect moderate correlations, smaller associations may not have been identified, and findings should therefore be interpreted as exploratory. Additional limitations include the absence of systematic assessment of potential confounders such as prior COVID-19 infection, cancer stage, treatment status and medications. Self-reported "pre-treatment" sensory perceptions may also be subject to recall bias and objective psychophysical sensory testing was not performed. Finally, while the sensory perception and oral symptom questionnaires showed acceptable internal consistency and sampling adequacy, full external validation of all instruments in this heterogeneous oncology population remains limited.

Nevertheless, the study addresses key gaps in the literature, which often focused mainly on head and neck cancers or assessed only qualitative or binary (present/absent) sensory changes. By examining a range of sensory alterations, including less-studied somatosensory dimensions and co-occurring oral symptoms, this study provides quantitative evidence on how sensory changes relate to food preferences and eating behaviour, an area often assumed to be clinically relevant but rarely documented in such detail. It thereby adds empirical clarity while highlighting the complexity and variability of sensory profiles in this population.

5. Conclusion

The study characterised sensory alterations and oral symptoms of patients with cancer, and how these factors relate to their food preferences and eating difficulties. A substantial proportion of participants reported sensory alterations, while oral symptoms such as dry mouth and sensitive teeth were frequently experienced. Larger, longitudinal studies with a more balanced distribution of patients across cancer types are warranted to enable robust comparisons across cancer types, treatment modalities, and stages. The findings indicate that sensory perception is linked to food preferences, and that more pronounced sensory alterations and oral symptoms are linked to greater eating challenges.

These findings suggest the potential value of considering sensory profiles when developing dietary strategies. Identifying sensory profiles may guide tailored dietary strategies that accommodate individual preferences, potentially improving food enjoyment, dietary intake, and quality of life, though further research is needed to evaluate practical applications.

Ethics approval and consent to participate

The study was approved by the Research Ethics Committees of the respective countries (University of Lyon, France, ref: 2022-04-19-002; University of Reading, UK, SREC 68/2022; University of Copenhagen, Denmark, CASE: 504-0326/22-5000). Patients could access the survey through an anonymous online link, where they were first presented with the study information sheet, and informed consent was obtained before initiating the survey. Patients were informed of their right to withdraw or request data removal at any point during the survey.

Clinical trial number

Not applicable.

Consent for publication

Not applicable.

Data availability

The data that support the findings of this study are not openly available and are available from the corresponding author upon reasonable request.

Author contributions

RRR: Conceptualization, Methodology, Investigation, Formal analysis, Writing - Original draft preparation, Writing - review and editing; **CK, NB, FC, AB, WB:** Conceptualization, Methodology, Writing - review and editing, Supervision; **SL**: Project administration, Methodology, Writing - review and editing; **AD, AG:** Conceptualization, Methodology, Writing - review and editing, Supervision, Project administration, Funding acquisition.

Declaration of generative AI in scientific writing

During the preparation of this manuscript, the author(s) used an AI-assisted language tool (ChatGPT, OpenAI) to refine the wording, grammar, sentence structure, and overall readability. The tool was not used for data analysis, interpretation, or the generation of scientific content. All text generated with assistance was thoroughly reviewed, verified, and revised by the author(s), who take full responsibility for the final manuscript.

Funding

A funding contribution was provided by the National Association for Research and Technology (Association Nationale Recherche et Technologie), Danone Global Research & Innovation Center, and National League Against Cancer (Ligue Contre le Cancer), yet the content of the work is the sole responsibility of the authors and do not necessarily represent the views of the funders. Open access funding for this publication was provided by University Claude Bernard Lyon 1.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The authors wish to thank Belinda Lange and Charlotte Dandanell for their assistance with the Danish translation of the questionnaires.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.nutos.2026.100645.

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