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Investigating the modifications of sugar perception and consumption in cancer patients

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Short title: Sugar perception in cancer patients

Abstract:

The idea that sugar feeds the tumour cells is relayed by some health professionals and media alike. Patients may be torn between what they read in the media and their food preferences during and after treatment. With this survey we aim at understanding the perception and overall consumption patterns of sugar in cancer patients together with possible physiological and psychological triggers. We decided not to include quantitative nutritional measures of the sugar consumption. The survey was distributed in a hospital setting and through a cancer support online network. Results have shown that opinion on sugar was globally “average”. However there were differences depending on sex and age. Half of the patients declared having a decreased consumption of sugar and sweet products while 26% declared an increased consumption. When looking at psychological triggers to consumption, the weight of fatigue and worry increased after cancer diagnosis compared to before. Environmental triggers such as mixed messages from health professionals or the media need to be further investigated. In line with ESPEN guidelines, we advise to maintain moderate sugar intake as part of a healthy diet to prevent malnutrition as a first line of defence against cancer-associated morbidity and mortality.

Keywords: Sugar perception, Sugar consumption, Cancer, Survey

Introduction

Dietary behaviour typically changes during cancer and its advanced stages (1). A cluster of different treatment-related symptoms can alter, impede or even prevent oral intake of food. According to the individual situations, patients can experience swallowing difficulties, dental receding, canker sores, gingivitis, a drying mouth, bowel and stomach pain, nausea, cognitive problems, constipation or, conversely, diarrhoea (2). Chewing, swallowing and dysphagia alterations aggravated other side effects and are associated with a substantial decrease of energy intake, thus having an important nutritional and health impact (3, 4). A study on the quality of the hospital food service in cancer care units showed that the patients turned away from fat, bitter, acid or metallic flavoured main courses, as well as smells of roasting and frying depending on the side effects they experienced (5, 6). Malnourished cancer patients treated by chemotherapy experience more episodes of toxicity (7). Clinicians believe that the effectiveness of chemotherapy in these patients is affected, toxicity increased and the prognosis aggravated (8, 9). This essentially iatrogenic undernutrition could be responsible for 5 to 25% of deaths in cancer patients (10).

A taste threshold study conducted for the NEODIA translational research programme (11) has shown that cancer patients presented a lower sensitivity threshold both to salt and sodium glutamate (Umami flavour). In this study, people in the control group recognized the sweet flavour in a 4g/L sugar solution, whereas 25% cancer patients were still unable to characterize the higher dose of 16 g/L. Furthermore, we observe that 37% patients were considering the dose of 32 g/L sugar as acceptable and 8% fully enjoyed it. This observation contrasted with 53% healthy people who turned away from the 16 g/L sugar solution.

Frequently asked questions on specialized websites and forums indicate that behaviour towards sugar and sugar containing products is of particular concern to cancer patients and survivors. Some professionals advise to avoid this source of energy during cancer. This

position is linked to the idea that sugar feeds and promotes the tumour cells. This is often relayed by the media to create a buzz. Those are also the first articles and web pages found on the internet when entering “sugar and cancer” keywords, creating a very negative image. This may create a gap between what patients are told by different sources and their food preferences, leading to mixed perception and behaviours toward sugar and sweet products.

From these observations, and considering our previous findings, the aim of this observational study was to investigate sugar consumption patterns and perception in cancer patients in France. The survey is targeting physiological and psychological triggers together with perception and self-assessment of sugar consumption but no quantitative nutritional measure of carbohydrates intake. The survey was addressed to patients in a clinical setting (walk-in clinic) and patients who are member of a cooking and nutrition support website. Hence a secondary aim was to investigate possible differences between the two populations.

Methods

Study design

This observational study employed a single-administration, self-administered survey questionnaire. The survey assessed demographic information, food preferences and perception (consumption and perception of sugar and sugar-containing products), symptoms and psychological factors that could affect consumption behaviour and perception and beliefs about sugar.

Study participants

Study participants were a convenience sample (n = 108) of adult patients who were currently treated in the oncology clinic of Beauvais France, identified as CHB patients, or participants of the vite-fait-bienfaits network, identified as VFBF patients. Vite-fait-bienfaits is an independent website offering nutritional and culinary advices to patients and professionals alike (11). Participants were eligible to complete the survey if they: (i) were at least 18 years of age; (ii)

had been diagnosed with cancer (any type or stage); (iii) were being seen for a medical appointment and/or treatment in outpatient chemotherapy or radiation oncology or registered in the mailing list of the vite-fait-bienfaits website; and (iv) could understand written and spoken French. Informed consent was waived because of the anonymous nature of the survey. No personal or medical data were recorded in either the CHB or VFBF setting that could lead to identification of the individuals and all patients had the choice to decline participating in the survey.

Procedure

- Recruitment

CHB patients were approached by a research assistant while waiting for a medical appointment or treatment, or during chemotherapy treatment. Whenever possible, an introduction of the research assistant and study topic were made by the patient's treatment team. VFBF patients were approached through an electronic invitation letter containing the link to the survey. VFBF members are cancer patients, their relatives, oncologists or dieticians looking for culinary and nutrition advices during treatment. We are thus confident that both sets of patients are both reliable and representative.

- Data collection

The research assistant provided a paper-format of the survey to willing participants to complete independently. He/she was available in clinic to answer any questions while participants completed survey items. All survey responses were transcribed into electronic format by the research assistant. The VFBF patients completed the survey in web-based format. Both sets of data were chelated into a single file for analysis.

Survey

The survey questionnaire included 28 questions. The questionnaire was specifically designed to determine sugar perception and consumption in relation to cancer treatment. Questions were

divided into 4 categories relating to sugar perception, sugar consumption, sugar and health, and descriptive questions to characterise the respondent.

The following demographic information was collected from all study participants: gender, age, marital/partner status, number of live-in children and professional situation. The following medical information was collected from study participants: primary cancer diagnosis, time since diagnosis and cancer treatment side effects. Information relative to sugar was based on recall with a number of items investigating changes in perception and behaviour towards sweet products before and since diagnosis. An English translation copy of the survey is present in supplementary material S1 including table of response frequency for each question.

Statistical analysis

Analysis of raw data was performed using SPAD statistical software (v9.0, Coheris). Results are expressed as frequency for qualitative variables and mean and standard deviation for quantitative variables. Global as well as subgroup (CHB, VFBF) analyses were performed. Univariate analyses were performed using Student t-test for quantitative and Khi-2 for qualitative variables. Khi-2 or Fisher tests were performed to investigate relations between variables for qualitative and quantitative/qualitative variables, respectively. Same tests were used to compare population subgroups.

Results

Description of the population

Target population were cancer patients, invited to answer the survey during visits to the oncology day units (chemotherapy and radiotherapy) at Beauvais Hospital or mailing to members of the vite-fait-bienfaits network. A total of 108 surveys were completed, 1 was excluded as not responding to age criterion (under 18 years of age). Of the 107 surveys recorded and analysed, 36 were collected from Beauvais hospital patients during visits and 71 had been completed online by VFBF members.

As shown in table 1, age, sex ratio and other characteristics of the population were different between the two groups of patients. While CHB patients were both men and women mostly in the active phases of treatment (up to 6 months since diagnosis) for a range of primary tumour sites, VFBF patients were mostly women and in post-treatment stages (more than 1 year since diagnosis) for breast cancer. When looking at the different symptoms reported by the patients, loss of appetite and nausea, common side-effects of chemotherapy and radiation treatments, were reported more frequently in CHB patients (41.7 and 52.8%, respectively) compared to VFBF patients (15.5 and 21.1%, respectively).

Studied populations were significantly different and representative of the recruitment settings. For the remainder of the article, we therefore decided to separate the two groups and focus on descriptive analyses and trends.

Sugar perception

General opinion on sugar (Q21) was “average”. Of the total respondents, 37.5% had a “good” or “excellent” opinion, 26.9% an “average” opinion and 35.6% a negative opinion, but this varied depending on the study group. Indeed, 61.8% of CHB patients had a positive opinion while they were only 25.7% VFBF patients ($\chi^2= 13.420$; $p= 0.001$).

A number of survey items were looking at the change of perception before and since the diagnosis and treatment (Q6). As seen in table 2, recall of feeling associated with sugar consumption before the onset of cancer was dominated by pleasure (88.6% in CHB and 68.1% in VFBF) followed by well-being (8.6% and 23.2%). Other feelings such as energy and disgust were only mentioned in the VFBF group. There was in both groups a strong modification of associated feeling since the onset of the cancer, although pleasure remained the strongest feeling (51.5 vs 45.6% in CHB and VFBF patients, respectively). In CHB patients, energy

increased by 30.3%, and disgust increased by 9.1%. In VFBF patient, however, well-being and disgust were equally increased by 10.6 and 11.8%, respectively.

When asked what psychological context triggered the need to consume sugar (Q10, Q11), 60.0% of the total population claimed that it was unchanged. When looking at the differences over time, however, we can see in table 2 that fatigue was increased by 27.7% after diagnosis in CHB patients and 10.3% in VFBF patients. In VFBF patients, another trigger was modified, worry, with an increase of 8.8% compared to before diagnosis.

Sugar consumption

Overall, 27% of the respondents did not change their overall consumption of sugar products (Q12), 26% declared they had increased it while 47% declared lower consumption. When looking at the two groups, decreased consumption was much stronger in VFBF population than CHB population (52.1 vs 38.2%, respectively) while increased consumption was higher in CHB than VFBF patients (29.4 vs 23.9%, respectively) but there was no group effect for the global population ($\chi^2= 1.807$; $p= 0.405$).

The decision to change eating patterns (Q13) was most often linked to the need to tackle a specific problem such as managing side effects from cancer treatment (51.7 vs 24.6% in CHB and VFBF patients, respectively), but the link was not significant for other reasons such as changing the taste of some food items (17.2 vs 26.1% of CHB and VFBF patients, respectively) or responding to a psychological need (20.7 vs 7.2% of CHB and VFBF patients, respectively), losing weight (3.4 vs 4.3% of CHB and VFBF patients, respectively) seemed anecdotic.

When looking more closely the top items that were either increased or decreased after the onset of the cancer (Q16, Q17), the two populations showed variations. In particular, modification of consumption of particular food items seem to be more frequent with VFBF patients, with 41.4% reduction in white sugar to 41.4% increase in fruit intake. CHB patients on the other hand had variations ranging from 17.6% decrease in chocolate intake to 14.7%

increase in fruits as seen in figure 1. Modulation of consumption for specific items differed between the two groups for white sugar ($\chi^2= 10.206$; $p= 0.006$), ice cream and sorbet ($\chi^2= 7.237$; $p= 0.027$), dairy desserts ($\chi^2= 11.550$; $p= 0.003$), chocolate ($\chi^2= 6.722$; $p= 0.035$) and fruits ($\chi^2= 7.187$; $p= 0.027$).

When asked the main occasion for sugar consumption (Q14), most answered breakfast (48.6 vs 31.0% in CHB and VFBF patients, respectively) or between meals (28.6 vs 56.3% in CHB and VFBF patients, respectively) ($\chi^2= 7.317$; $p= 0.026$).

Looking more specifically to the top items consumed daily (Q15), we observed differences in the nature of the favourite items as well as percentage of the population selecting such items. CHB patients declared consuming white sugar (58.8%), sweet dairy product (58.3%), pastries/biscuits (54.3%), fruit (44.1%) and honey/jam (41.2%) while VFBF patients consumed mostly fruit (77.6%), chocolate (50.7%), honey/jam (47.1%), fruit juice (29.0%) and pastries/biscuits (25.7%).

Sugar and health perceptions

When asked about the link between excess sugar consumption and chronic disorders (Q19), cancer was selected by 31.8% of respondents (11.1 vs 42.3% in CHB and VFBF patients, respectively ($\chi^2= 10.687$; $p= 0.001$)), far behind diabetes (75.7%), tooth decay (76.6%) and obesity (81.3%).

When asked specifically about the link between sugars and cancer (Q20), the majority (67.9 v 34.5% in CHB and VFBF patients, respectively) did not have a clear opinion. Of the remaining respondents, 17.9 and 10.3% of CHB and VFBF patients, respectively, thought that there was no link, 7.1 and 12.1% of CHB and VFBF patients, respectively, thought that there was an indirect link through obesity, while 7.1 and 43.1% of CHB and VFBF patients, respectively, stated that sugar fed the tumour cells ($\chi^2= 13.687$; $p= 0.003$).

Regarding information gathering, 44% of patients did not look for a second opinion (Q4) once they trust the primary source. Those trusted sources (Q3) did not seem to be the media (only 26% of patients) but rather health professionals (at least 83% trust level for oncologists, general practitioners or nurses). However they were only 65% who trust dieticians and surprisingly 20% of patients thought that dieticians' advice would not have an impact on their health status.

Finally, when asked for the first word that comes to mind about sugar (Q18), 29.1 vs 10.5% of CHB and VFBF patients, respectively referred to specific products or a sensory word relating to taste, 25.8 vs 47.8% of CHB and VFBF patients, respectively gave a word showing positive feelings (softness, pleasure), 32.2 vs 10.5% of CHB and VFBF patients, respectively referred to consumption behaviours (mostly positive), and finally 12.9 vs 31.4% gave a word associated with health risks or negative feelings for CHB and VFBF patients, respectively ($\chi^2= 19.882$; $p= 0.003$).

Bivariate analyses

First of all, we investigated the general opinion on sugar. Variations between groups may be explained by a number of possible confounding factors. Indeed, opinion on sugars seemed to be dependent on sex ($\text{Khi-2}= 24.316$; $p=0.000$ for the total population), opinion being more favourable in men than women. The trend remained for the VFBF but not the CHB subgroup. The general opinion also seems to be dependent on age ($\chi^2= 9.515$; $p=0.009$) with higher opinion expressed in older (55 and over) compared to younger population. Again, the trend remained for the VFBF but not the CHB subgroup. Finally no clear trend could be found between the general opinion and stage of disease ($\chi^2= 4.254$; $p=0.373$). No relationship could be found either between opinion and the type of tumour.

Investigating the relationship between changes in sugar consumption and the new perception associated with sugars, there was a strong interaction between the two parameters ($\chi^2=$

30.606; $p= 0.000$ on the total population). Overall, a stable consumption was mostly associated with a feeling of pleasure (76.0%). Similarly, disgust was associated with reduced consumption (91.7%) and energy with increased consumption (71.4%). When looking at the two groups separately, the interaction remains ($\chi^2= 14.334$; $p= 0.026$ and $\chi^2= 16.637$; $p= 0.011$ for CHB and VFBF patients, respectively) but individual trends were more difficult to emphasize due to smaller size of groups. When the change in consumption was tested against symptoms, no clear pattern was detected. Finally, when the reason and change of consumption were tested together, psychological need was associated with increased sugar consumption ($\chi^2= 8.697$; $p= 0.003$) in the global population. The trend remained for the VFBF subgroup ($\chi^2= 4.716$; $p= 0.030$) but not CHB patients.

Looking at perception of sugar and symptoms associated with treatment, change of taste was linked to sugar being perceived for its energy value in the CHB group ($\chi^2= 6.233$; $p= 0.013$). No other relationships were detected in either populations. Finally, when perception of sugar was tested against triggers for consumption, we observed a link between perception of energy and fatigue as a trigger for consumption in the CHB group ($\chi^2= 6.474$; $p= 0.011$) and between perception of disgust and anger as a trigger in the VFBF group ($\chi^2= 4.518$; $p= 0.034$). No other relationships were detected in either populations.

Discussion

The present study has found considerable variations in the consumption of sugar and sweet food items as well as in the psychological triggers in the two distinct cancer patient groups, although the perception associated with sugar taste appeared to be mostly similar.

Perception and changes in smell and taste function

Our present survey showed that perception of sugar shifted from pleasure to more functional aspects (energy) or negative perception (disgust). We also observed that sugar being

perceived for its energy value was associated to alteration of taste, one of the most common side effects of cancer treatment, both through chemotherapy and radiation therapy.

Alteration of taste can be present in 15 to 100% of cancer patients (12, 13) and is present in our target populations as the 4th most described symptom. In a study on 50 cancer patients, reduced taste was present for 50% of the patients and associated with increased seasoning, using spices and flavouring on savoury dishes, sugar on sweet items (14). Taste threshold for sucrose was greatly increased in cancer patients compared to control population and was further linked to decreased taste. This is in agreement with our previous findings (11). Bitterness was increased associated with coffee and chocolate, inducing an aversion for these items (14), which could explain the ambivalent response in this study population toward chocolate. Long term taste changes seem to affect up to 18% of cancer survivors and show modification of mostly bitter and salty tastes as opposed to salty and sweet taste modification being prevalent during treatment (15).

Food preferences and learned food aversions

Our study has shown a shift in perception of some food items, suggesting alteration of food preferences. Combination of taste and smell dysfunction together with toxic side effects of treatment also lead to learned food aversions, a phenomenon that is often associated with studies of food preferences in cancer patients.

When looking at food preferences and aversions, milky desserts and fruits were in the preference list while sweets and chocolate were commonly reported aversions (16, 17). Again this is in agreement with some of our findings. As our study is transversal and investigating patients that are currently undergoing chemotherapy or radiation therapy as well as patients that are further from initial diagnosis, it is difficult to assess the time-dependent response to sweet taste. In a study investigating treatment-linked and anticipatory nausea and vomiting and coping behaviours by cancer patients undergoing chemotherapy, Boakes et al observed an increased liking in sweet items including chocolate and fizzy drinks, fruits and fruit juices

(18). The fruit and juice data can be correlated with our own findings, response toward chocolate and fizzy drinks is less clear in our study population. The reasons behind changes consumption or liking are similar to those in our study with change of taste or tackling of side-effects being offered the more frequently. Another recent study in haematology cancer patients reported fresh fruits and ice cream as part of the favourite food items, associated with an hedonic dimension beyond taste (19). Again the same food items were found in our study populations. Fruits were the most reported favourite food while sweets were on the aversion list. However women were more likely than men to avoid sweets and dairy products, indicating a sex-dependent impact of food preferences and aversions (20). Our study was not designed to identify food aversion but the changes in consumption of normal food items that we measured may be linked to such conditioning.

The link between dietary sugar and cancer development

The “sugar feeds cancer” concept is well known among the medical community but also largely diffused by the media to reach the patient. It is accepted that cancer cells are not energy efficient and as such use glucose at a much higher rate than non-cancer cells (21). Due to the Warburg effect, cancer cells use glycolysis pathways even under normoxic conditions, the energy output is thus inefficient, explaining the increased requirement for carbohydrates typical to cancer cells (22). While the tumour cells show increased metabolic activity, they also have high degree of anaerobic glycolysis and uptake of amino acids as energy source independently to the dietary sources of energy (23).

Hence caution towards biological impact of glucose should not translate to a clinical recommendation to cancer patients to avoid eating glucose or simple sugars (24). There are two main reasons for that. First of all, avoiding sugar intake would prove challenging for patients because carbohydrates constitute the largest proportion of the Recommended Daily Intake (RDI) among the three macronutrients. Secondly, while ketogenic diet makes sense at reducing exogenous carbohydrates as a mean to starve cancer cells, neoglucogenesis would

occur to provide endogenous glucose concentrations for the good upkeep of normal tissues. ESPEN guidelines on nutrition in cancer patients state that theoretical arguments that nutrients “feed the tumour” are not supported by evidence related to clinical outcome and should not be used to refuse, diminish, or stop feeding as dangers of malnutrition on quality of life and the risk of reductions or interruptions of scheduled anticancer treatments are important (25).

In addition, while ketogenic diets have been tested as a mean to deprive the tumour cells from their fuel (glucose), there is not enough clinical data to show a clear benefit for this high-fat low-carbohydrate diet and a number of side effects have been reported, mainly in terms of renal damage and circulating ketone bodies or digestive discomfort (vomiting and nausea) that are already common side effects of radiotherapy and chemotherapy (26, 27).

Limitations of the study

The survey was made available to all patients in the CHB walk-in oncology clinics and VFBB members but only those volunteering to respond are represented herein. As such, patients were self-selected and were possibly more willing to discuss food preferences and dietary habits or more eager to search for information about their disease compared to the overall population in those two groups so we do not know how participants may have differed from those who declined to participate, which limits generalizability of findings. In addition, it is now accepted that the nature of the cytotoxic agent (chemotherapy) will impact on the nature and intensity of the side-effects (28, 29). Added to the tumour site and its functional links to the digestive tract and sensory receptors, this means that each patient has their own specific range of food perception. Such a selection bias is unfortunately difficult to avoid and the limited number of respondents reduces the representability of the results. However it allowed us to identify a number of perceptions, behaviours and triggers that can be investigated more in depth in a later protocol.

Food preference can be triggered by a large number of stimuli, both internal and environmental. As such, measuring it requires a strict methodological approach to limit intervention bias (30). De Bruijn et al. demonstrated that food preferences (sweet vs savoury) and inclination for specific macronutrients (carbohydrate vs protein or fat) depended in part upon the fullness and nature of the previous meal. Hence it would be important to standardise the conditions relative to meals in which patients are presented with the survey.

In addition, this was a cross-sectional study so only associations (and not causality) could be examined. We attempted to address temporality by asking about changes since beginning treatment. However prior perception of sugar as energy and disgust were only mentioned in the VFBF group. This could be due to a bias in recall due to a longer time living with the disease and required homogeneous target population.

Perspectives

With the large number of unreliable information present on the internet or other generic sources, it is extremely difficult for the patient to have a clear understanding of a proper behaviour to have toward sugar consumption or any other dietary change. A number of tools have been developed in recent years including some cancer support care websites. For exemple, <http://www.voedingenkankerinfo.nl/> in the Netherland, created from a partnership between Wageningen University and the Netherlands Comprehensive Cancer Organisation, or <http://www.vite-fait-bienfaits.fr/> in France, created in partnership between UniLaSalle and the French Cancer League, have the objective to offer clear and scientific answers to the patients regarding nutrition and cancer (11, 31). A recent paper on trust issues regarding online health forums (32) emphasizes the importance of the perceived legitimacy of the hosting website (here the Breast cancer care charity in the UK). When looking at a number of web forums and talking to scientific, medical and paramedical professionals the question of the behaviour toward sugar and cancer divides the opinions. The message being ambiguous from

the “expert” point of view, it is even more so for the patient. Indeed we observed a strong impact of the environment and information gathered by the patient through medical and paramedical staff, the media, other patients, friends and family that strengthened the belief in the critical role of sugars in the aetiology of their disease. A study aiming at better understanding how health professionals build their inner convictions and decide on what nutritional advice to give their patients is underway.

Dietary changes following the onset of the disease may have a number of triggers, as we have seen in this study. One of them is the feeling of doing something, whether they believe that there is a link between the diet and cancer onset or prognosis, patients may feel that being somehow in charge of their health and doing something proactive about it is acting as a psychological boost on the road to recovery and self-healing (33).

Conclusions

The role of nutritional counselling is critical to improve the quality of life of the patient. In this spirit it is essential for the health professionals to recognise the need of the patient for unbiased and meaningful discussion on what nutritional changes can or cannot achieve and on the risks associated with an inadequate or restrictive diet (25, 34).

When considering the two population subsets, it is unclear if the difference in sugar perception is due to demographic parameters (sex, age) or to the impact of the proactive pattern toward healthy dietary habits that is characteristic of the VFBF group.

While global changes in sugar consumption can be varied, stable consumption was associated with feelings of pleasure when consuming sugars; increased consumption was associated with fatigue and the perception of the energetic value of carbohydrates; decreased consumption, finally was associated with negative feelings and triggers. These need to be further investigated to see if these factors can be used to better control risks of malnutrition and provide dietary advice in cancer patients.

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Conflict of interest

None to declare.

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Figure 1: Modification of consumption of sweet/sugary food items (percentage increase/decrease consumption since diagnosis)

Selection of top 11 food items with the most variation since cancer diagnosis for CHB (grey) and VFBF (black) populations. Variation calculated as the difference between the frequency of respondents having increased their consumption and that of the respondents having decreased it for each food item.

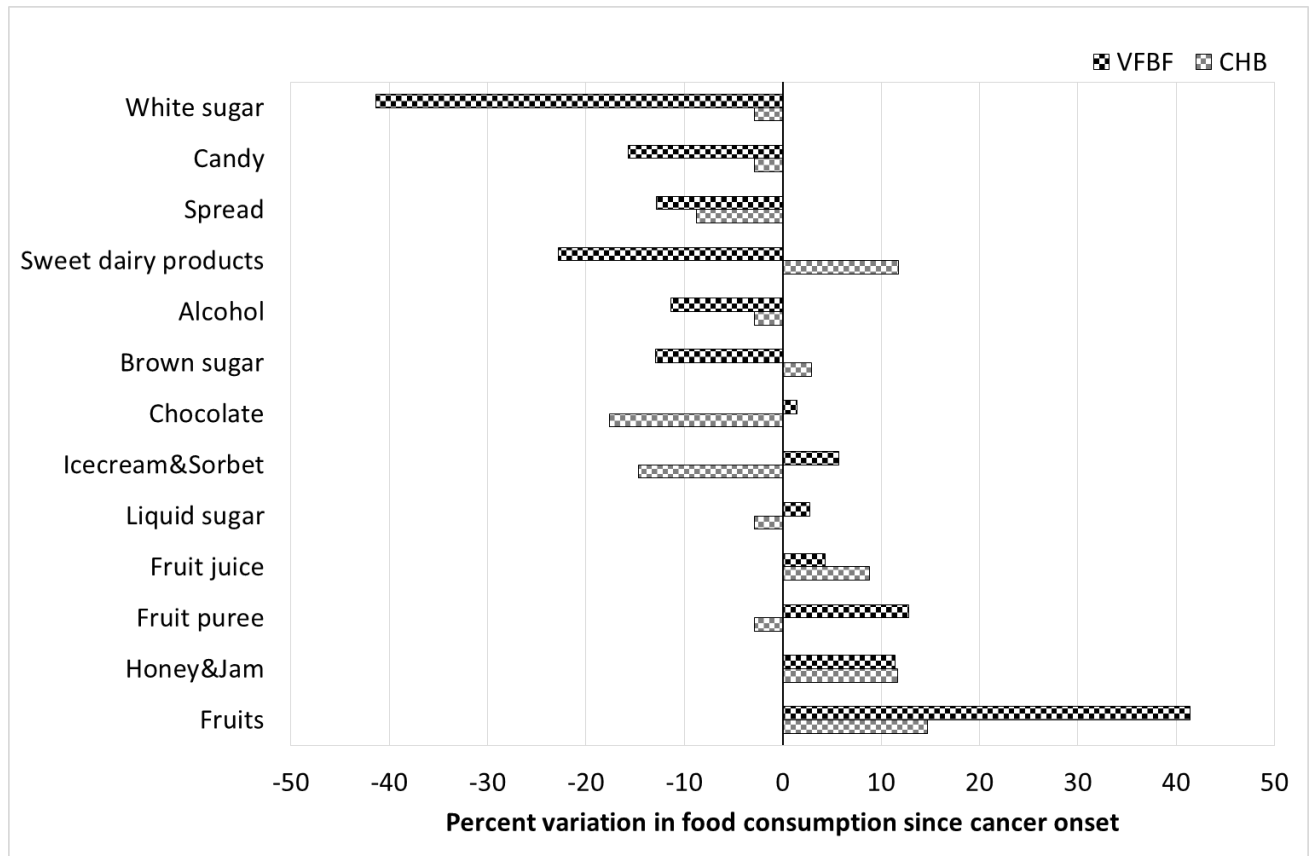


Table 1: Population characteristic

Descriptive demographic characteristics of the respondents from the two study populations expressed as percentage of the respondents. Data are analysed with Khi-2 test except for age (Student test) for comparison between target populations.

CHB: Beauvais hospital, walk-in oncology clinic; VFBF: cancer patients member of the mailing list of the vite-fait-bienfaits website. * Statistically significant ($p < 0.05$) with p value indicated in parentheses. n/a not applicable.

	CHB (n= 36)	VFBF (n= 71)	KHI-2 (p-value)	Total (n= 107)
Sex (%) <i>Female</i>	55.6	85.9	11.970 (0.001)*	75.7
Age (years) <i>Mean (SD)</i>	58.7 (11.6)	51.4 (13.1)	(0.006)*	54.0 (13.0)
Professional activity (%) <i>Currently working</i>	50.0	55.1	5.635 (0.060)	53.6
Time since first diagnosis (%) <i>0 - 6 months</i>	45.7	20.6	7.136 (0.028)*	29.1
<i>7 - 12 months</i>	17.1	27.9		24.3
<i>over 1 year</i>	37.1	51.5		46.6
Marital status (%) <i>Single</i>	28.6	36.4	0.622 (0.430)	33.7
Live-in children (%) <i>None</i>	73.5	61.8	1.392 (0.238)	65.7
Primary tumour site (%) <i>Breast</i>	27.8	65.7	13.482 (0.000)*	52.4
Frequently reported symptoms (%) <i>Top 5 ranking</i>	Tiredness (86.1) Nausea (52.8) Lost appetite (41.7) Change taste (41.6) Mouth dryness (33.3)	Tiredness (81.7) Constipation (42.3) Bloating (28.2) Change of taste (26.8) Mouth dryness (26.8)	n/a	Tiredness (83.2) Constipation (31.8) Nausea (31.8) Change of taste (31.8) Mouth dryness (29.0)

Table 2: Perception associated with sugar taste, and triggers of sugar consumption.

Before and After perceptions and triggers were assessed through the survey. Data are expressed as percentage of respondents. As triggers was a multiple choice question, the total percentage can exceed 100 for each column.

	CHB (n= 36)		VFBF (n= 71)	
	Before disease (%)	Since disease (%)	Before disease (%)	Since disease (%)
<i>Perception associated with sugar taste</i>				
Pleasure	88,6	51,5	68,1	45,6
Well-being	8,6	9,1	23,2	33,8
Energy	0	30,3	7,2	7,4
Disgust	0	9,1	1,4	13,2
<i>Triggers of sugar consumption</i>				
Anger	2,9	2,8	7	8,6
Happyness	8,6	5,6	11,3	10
Fatigue	2,9	30,6	21,1	31,4
Worry	5,7	2,8	14,1	22,9
Sadness	8,6	2,8	11,3	12,9
Stress	2,9	2,8	26,8	28,6
Relaxation	5,7	5,6	38	30
Any occasion	71,4	58,3	38	34,3

**Scientific Investigation to advance CANCER RESEARCH
Sugar and sweet taste in adults treated for cancer**

NEODIA is a research program conducted by the Institut Polytechnique UniLaSalle, which studies the eating behavior of patients treated for cancer. Since 2010, with our partners, we have launched various surveys aimed at improving the patient's daily life (fiber, milk, red meat, cooking...). We are now interested by "the sweet taste".

	% answer CHB	% answer VFBF
<u>Preliminary questions</u>		
1. Before the disease, were you in one or more of the following diets? <input type="checkbox"/> Diabetic <input type="checkbox"/> Sport (muscle build) <input type="checkbox"/> ketogenic diet (low in carbohydrates) <input type="checkbox"/> Weight loss <input type="checkbox"/> Fasting <input type="checkbox"/> None of the above	100	100
2. Since the disease, which symptoms disrupt your daily life? <input type="checkbox"/> Fatigue <input type="checkbox"/> Dryness mouth muco <input type="checkbox"/> Quick satiety <input type="checkbox"/> Constipation <input type="checkbox"/> Nausea <input type="checkbox"/> Bad taste <input type="checkbox"/> Inflamed esophagus <input type="checkbox"/> Diarrhoea <input type="checkbox"/> Vomiting <input type="checkbox"/> Gustative distortion <input type="checkbox"/> Gastric reflux <input type="checkbox"/> Clay-colored stools <input type="checkbox"/> Loss of appetite <input type="checkbox"/> Olfactory distortion <input type="checkbox"/> Heartburns <input type="checkbox"/> None of the above <input type="checkbox"/> Mucositis.Aphts <input type="checkbox"/> Swallowing difficulties <input type="checkbox"/> Bloating <input type="checkbox"/> Chewing difficulties <input type="checkbox"/> Inflamed throat <input type="checkbox"/> Inflamed stomach	100	100
<u>Sources of information</u>		
3. Note your confidence level for the following health information sources. General practitioner Oncologist <input type="checkbox"/> Full confidence Pharmacist <input type="checkbox"/> Acceptable confidence Dietician <input type="checkbox"/> Little confidence Nurse <input type="checkbox"/> Lack of confidence Press/TV/Internet <input type="checkbox"/> Not concerned Material available at healthcare practices (leaflets...) Family/Friends Other patients	78.4	94.5
4. Are you looking for other advices to reassure you? <input type="checkbox"/> Yes, often <input type="checkbox"/> Yes, sometimes <input type="checkbox"/> No, rarely or never	94.4	100
5. Do you like the sweet taste? Before diagnosis <input type="checkbox"/> Yes Since diagnosis <input type="checkbox"/> Moderately <input type="checkbox"/> No	54.2	95.8
6. What is the main feeling associated with sweetness? Before diagnosis <input type="checkbox"/> Pleasure Since diagnosis <input type="checkbox"/> Energy <input type="checkbox"/> Intellectual stimulation <input type="checkbox"/> Well-being / Comfort <input type="checkbox"/> Distaste / Stress	94.4	96.5

<p>7. Currently, are you consuming sugar and / or sweet products? <input type="checkbox"/> Never <input type="checkbox"/> A little <input type="checkbox"/> With moderation <input type="checkbox"/> Often</p>	11.1	90.1
<p>8. Do you have a preference for a type of sweet product? If yes which? (eg cakes, candies, fruit puree, jam, chocolate, soda ...)</p> <div style="border: 1px solid black; height: 20px; width: 560px;"></div>	97.2	87.3
<p>9. Was this favorite product the same before the disease? If not, what was it?</p> <div style="border: 1px solid black; height: 20px; width: 560px;"></div>	94.4	76.1
<p>10. Currently, in what psychological situation do you consume sugar or sweet products? <input type="checkbox"/> Indifferent <input type="checkbox"/> Anger <input type="checkbox"/> Happiness <input type="checkbox"/> Not a sugar consumer <input type="checkbox"/> Fatigue <input type="checkbox"/> Concern/Worry <input type="checkbox"/> Sadness <input type="checkbox"/> Stress <input type="checkbox"/> Relaxing time <input type="checkbox"/> Other</p>	100	98.6
<p>11. And before the disease? <input type="checkbox"/> Indifferent <input type="checkbox"/> Anger <input type="checkbox"/> Happiness <input type="checkbox"/> Not a sugar consumer <input type="checkbox"/> Fatigue <input type="checkbox"/> Concern/Worry <input type="checkbox"/> Sadness <input type="checkbox"/> Same situation(s) as before <input type="checkbox"/> Stress <input type="checkbox"/> Relaxing time <input type="checkbox"/> Other</p>	97.2	100
<p>12. In general, since the disease, has your consumption of sugar and sweet products changed? <input type="checkbox"/> Not significantly <input type="checkbox"/> I consume less <input type="checkbox"/> I consume more</p>	94.4	100
<p>13. If your consumption has changed, in your opinion, what are the main reasons? <input type="checkbox"/> To reduce symptoms <input type="checkbox"/> Due to medical advice <input type="checkbox"/> Information research <input type="checkbox"/> Other <input type="checkbox"/> Change of taste <input type="checkbox"/> Personal choice <input type="checkbox"/> Patient testimony</p>	61.1	73.2
<p>14. Currently, at what time of the day do you preferably consume sweet products? <input type="checkbox"/> Breakfast <input type="checkbox"/> Teatime/Snack <input type="checkbox"/> Between meals <input type="checkbox"/> Lunch <input type="checkbox"/> Dinner</p>	97.2	100

<p>15. How often do you consume the following sweet products?</p> <p>White sugar</p> <p>Brown sugar</p> <p>Liquid sugar (agave, birch, maple)</p> <p>Powdered or liquid sweetener (stevia, aspartame, sucralose...)</p> <p>Sweet beverages (soda, sirop...)</p> <p>Alcoholic beverages (beer, wine, cocktail...)</p> <p>Sweets, fruit pastes <input type="checkbox"/> Never</p> <p>Ice-cream, sorbet <input type="checkbox"/> Rarely (1/month)</p> <p>Dairy products containing added sugars <input type="checkbox"/> Sometimes (1/week)</p> <p>Lactose-free milk <input type="checkbox"/> Often (1/day)</p> <p>Cakes, pastries <input type="checkbox"/> Very often (over 1/day)</p> <p>Bread</p> <p>Fruit nectar</p> <p>Fruit juice</p> <p>Chocolate</p> <p>Fresh or dry fruits</p> <p>Honey, jam</p> <p>Spread</p> <p>Fruit compote</p> <p>Low-sugar products or sugar-free products</p> <p>Sweet/savory products, sweet sauces (ketchup, sweet-and-sour sauce)</p>	88.5	96.6
<p>16. Of all these sweet products, which ones do you consume MORE since the disease?</p> <p><input type="checkbox"/> White sugar <input type="checkbox"/> Brown sugar</p> <p><input type="checkbox"/> Liquid sugar (agave, birch, maple) <input type="checkbox"/> Powdered or liquid sweetener</p> <p><input type="checkbox"/> Sweet beverages (soda, sirop...) <input type="checkbox"/> Alcoholic beverages (beer, wine, cocktail...)</p> <p><input type="checkbox"/> Sweets, fruit pastes <input type="checkbox"/> Ice-cream, sorbet</p> <p><input type="checkbox"/> Dairy products containing added sugars <input type="checkbox"/> Lactose-free milk</p> <p><input type="checkbox"/> Cakes, pastries <input type="checkbox"/> Bread</p> <p><input type="checkbox"/> Fruit nectar <input type="checkbox"/> Fruit juice</p> <p><input type="checkbox"/> Chocolate <input type="checkbox"/> Fresh or dry fruits</p> <p><input type="checkbox"/> Honey, jam <input type="checkbox"/> Spread</p> <p><input type="checkbox"/> Fruit compote <input type="checkbox"/> Low-sugar products or sugar-free products</p> <p><input type="checkbox"/> None of the above</p>	94.4	98.6

<p>17. Of all these sweet products, which ones do you consume LESS since the disease?</p> <p><input type="checkbox"/> White sugar <input type="checkbox"/> Brown sugar <input type="checkbox"/> Liquid sugar (agave, birch, maple) <input type="checkbox"/> Powdered or liquid sweetener <input type="checkbox"/> Sweet beverages (soda, sirop...) <input type="checkbox"/> Alcoholic beverages (beer, wine, cocktail...) <input type="checkbox"/> Sweets, fruit pastes <input type="checkbox"/> Ice-cream, sorbet <input type="checkbox"/> Dairy products containing added sugars <input type="checkbox"/> Lactose-free milk <input type="checkbox"/> Cakes, pastries <input type="checkbox"/> Bread <input type="checkbox"/> Fruit nectar <input type="checkbox"/> Fruit juice <input type="checkbox"/> Chocolate <input type="checkbox"/> Fresh or dry fruits <input type="checkbox"/> Honey, jam <input type="checkbox"/> Spread <input type="checkbox"/> Fruit compote <input type="checkbox"/> Low-sugar products or sugar-free products <input type="checkbox"/> None of the above</p>	94.4	98.6
<p><u>Perception of sugar</u></p> <p>18. Write the first word that comes to your mind to characterize sugar?</p> <p><input type="text"/></p>	86.1	94.4
<p>19. In your opinion, to what health problems would the over-consumption of sugar be associated?</p> <p><input type="checkbox"/> Tooth decay <input type="checkbox"/> Strokes <input type="checkbox"/> High cholesterol <input type="checkbox"/> Diabetes <input type="checkbox"/> Cardiovascular diseases <input type="checkbox"/> Obesity <input type="checkbox"/> Cancer</p>	100	100
<p>20. What link do you think there is between sugar and cancer? (you can use keywords or short sentences)</p> <p><input type="text"/></p>	77.8	81.7
<p>21. What is your general opinion on sugar and sweet products?</p> <p><input type="checkbox"/> Low/Bad <input type="checkbox"/> Moderate <input type="checkbox"/> Excellent <input type="checkbox"/> Acceptable <input type="checkbox"/> Good</p>	94.4	98.6
<p><u>Additional informations</u></p> <p>22. You are?</p> <p><input type="checkbox"/> Man <input type="checkbox"/> Woman</p>	100	100
<p>23. How old are you?</p> <p><input type="text"/></p>	100	90.1
<p>24. What is your professional situation?</p> <p><input type="checkbox"/> Farmer <input type="checkbox"/> Shopkeeper <input type="checkbox"/> senior executive <input type="checkbox"/> Other <input type="checkbox"/> Worker <input type="checkbox"/> Employee <input type="checkbox"/> Retired <input type="checkbox"/> Artisan <input type="checkbox"/> Company director <input type="checkbox"/> No professional activity</p>	100	97.2
<p>25. How long have you been on treatment?</p> <p><input type="checkbox"/> 0-3 months <input type="checkbox"/> 4-6 months <input type="checkbox"/> 7-12 months <input type="checkbox"/> More than 1 year</p>	97.2	95.8
<p>26. What is the primary location of the tumor?</p> <p><input type="text"/></p>	100	94.4

27. What is your marital situation? <input type="checkbox"/> Single <input type="checkbox"/> Attached	97.2	93
28. How many dependent children do you have? <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> More than 2	94.4	95.8