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Original article

Taste preference of patients shortly after surgery in the Post Anaesthesia Care Unit (PACU)



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SUMMARY

Background & aims: Early postoperative oral feeding is safe and enhances recovery after surgery. To facilitate oral intake directly after surgery in the Post Anaesthesia Care Unit (PACU) and to enhance its associated benefits, knowledge on what patients would like to eat and/or drink is essential. Data on taste preferences in the immediate postoperative period is scarce, therefore this study investigated the taste preference of patients directly after surgery in the PACU.

Methods: A prospective observational study in adult patients scheduled for elective surgery under general anaesthesia. Taste preference was our primary outcome, for which we used the Macronutrient and Taste Preference Ranking Task (MTPRT) questionnaire. As secondary outcomes we asked additional questions to evaluate specific food characteristics separately, including consistency, texture, and temperature of food/drinks. Finally, we evaluated the appetite of our patients, using descriptive statistics, and analysing differences in the MTPRT liking scores.

Results: We included 57 surgical patients. The MTPRT liking data showed that our patients liked low-energy products with a sweet taste the most. The MTPRT ranking data showed a dislike for high-protein products. Data from the additional questionnaire revealed that our patients seemed to like food products with soft, juicy, crispy, hot and cold characteristics. The majority of patients ($n = 44$, 79 %) did have an appetite for food directly after surgery during their PACU admission.

Conclusion: This study showed that postoperative patients in the PACU tended to like low-energy food products with a sweet taste the most. In addition, this study showed that patients seemed to favour a broad variety of food products directly after surgery. Due to our small sample size the results should be interpreted with caution, but they do provide initial insights to help improve PACU food services, and thereby can contribute to enhance early postoperative oral intake.

Registered at NTR (trialregister.nl) with study ID Trial NL9048.

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1. Introduction

Early postoperative nutrition is safe and enhances recovery after surgery [1]. Prolonged postoperative fasting has a negative influence on postoperative morbidity and increases length of hospital

stay [1–3]. However, starting nutritional intake as soon as possible after surgery, in line with the postoperative fasting guidelines, appears difficult [1,4,5]. Lack of knowledge about postoperative nutritional intake amongst care providers, and especially knowledge on what patients would like to eat and/or drink directly after surgery, might be one of the barriers that obstruct the ability to feed patients directly after surgery [6].

In general, food preferences are influenced by multiple factors. Physiological, nutritional, environmental, and cultural aspects are

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important, but also shape of food products, sensory characteristics, and individual food choices affect food preference [7]. General flavour experience is defined by multiple sensory aspects, such as the five basic taste qualities (sweet, sour, salty, bitter, and umami/savoury), smell, texture, temperature and appearance of a food [8,9]. Interestingly, there is an universal, inborn preference towards products with a sweet taste [10], since in nature most sweet products are a high-calorie energy source [11]. Furthermore, food products that are high-caloric and/or high-fat tend to be the most palatable [12]. Taste perception and the specific nutritional components of food products are related. For instance, a part of the perception of sweetness can be attributed to the presence of mono- and disaccharides, which are carbohydrates. Similarly, the perception of saltiness is related to the level of sodium, and the perception of umami/savoury is related to protein content of a food [13,14].

Despite extensive research on taste preference in hospitalized oncological patients, there has been limited research on taste preferences in postoperative patients. Yeung et al. showed, in 145 colorectal surgery patients that they wanted solid simple foods over clear fluids as their first intake after surgery [15]. However, this study showed the food preference of postoperative patients on their first and second day after surgery, but not on the day of surgery. In another study, Welchman et al. showed, in 31 colorectal surgery patients, that savoury and sweet food products were favoured in the postoperative period in the surgical ward. Their postoperative period studied ranged from the first day after surgery until the third [16].

Until date it is unknown what postoperative patients would like to eat directly after surgery, at the day of surgery. To be able to facilitate early oral intake directly after surgery, according to the guidelines, we aimed to investigate taste preferences of patients in the first hours after surgery in the Post Anaesthesia Care Unit (PACU). We think that it is important to start oral intake already at the PACU, because it will stimulate gastrointestinal motility and ease the resumption of normal bowel function as soon as possible after surgery, thereby facilitating postoperative recovery [17].

In this prospective observational study, we evaluated the taste preference of postoperative patients in the PACU using the validated Macronutrient and Taste Preference Ranking Task (MTPRT) questionnaire and a non-validated additional questionnaire regarding specific food characteristics.

2. Materials & methods

2.1. Study design

This study was a prospective observational study performed from November 11th 2020 until December 8th 2020 in the PACU of the Amsterdam University Medical Centres (Amsterdam UMC), location AMC, The Netherlands. Adult patients who underwent elective surgery under general anaesthesia and had postoperative care at the PACU were included. Exclusion criteria were unable to speak and/or understand the Dutch language, unable to give informed consent, clinical nutrition (enteral and/or parenteral) postoperatively, a vegetarian/vegan diet (due to the inclusion of animal-based food groups in the used questionnaire), or PACU admittance after 5 p.m.

The study was performed according to the principles of the Declaration of Helsinki (Helsinki, 2024) [18] and written informed consent was obtained from each participant. The Institutional Review Board of the Amsterdam UMC, location AMC confirmed that the study did not fall under the Medical Research with Human Subjects Act (November 12th 2020, W20_484#20.536). The trial was registered in the Dutch Trial Register (NTR) with trial number

NL 9048 (Home | Research with human participants (onderzoekmetmensen.nl)).

2.2. Study outcomes

Our primary outcome was taste preference determined by the validated Macronutrient and Taste Preference Ranking Task (MTPRT) questionnaire [19]. The MTPRT contains 32 pictures of food products from four macronutrient categories (high-carbohydrate, high-fat, high-protein, and low-energy) with a sweet or savoury taste (see Supplement 1). Every macronutrient category consisted of eight items. For every category, there was an even distribution of four items being sweet and four being savoury.

The MTPRT questionnaire consists of two parts. In the 'liking' part, patients scored each food product separately on a 100-point visual analogue scale (VAS), starting from 'do not like at all' (score 0) to 'like extremely' (score 100). In the 'ranking' part, patients ranked food products per set of four, with a score per food product ranging from 4 to 1. For each set of four, the food product they would like to eat the most was ranked first (score 4), and the one they liked the least was ranked last (score 1). Multiple sets of four food products were given to the patients to be ranked on an iPad. An overall score per macronutrient or taste category was calculated at the end. The higher the score category, the more the patient favoured that category compared to the other. A score >2.5 was defined as a preference for that category [19]. For interpretation of the results, we valued the liking part of the MTPRT more, since we studied taste preference at one specific moment in time, and not evaluated taste preference changes over time. This is in line with de Bruijn et al., who state that the MTPRT ranking part is especially sensitive in detecting changes over time [19].

Our secondary outcomes consisted of the results of an additional questionnaire to evaluate specific food characteristics (see [Questionnaire 1](#)). This questionnaire consisted of questions to determine preferences of specific food characteristics, such as the five basic taste qualities, food consistency, texture, temperature, and appetite levels. In contrast to the MTPRT, this additional questionnaire is not validated, it includes three more taste qualities, and it has some different food products. For interpretation of the results, since the MTPRT is a validated questionnaire, the outcomes of the MTPRT questionnaire are valued more than the additional questionnaire outcomes.

2.3. Study procedures and data collection

Eligible patients were contacted preoperatively by telephone or in person at the surgical ward. After surgery, when the patients were awake and alert, patients were asked to fill in the online MTPRT questionnaire on an iPad, and to fill in the additional questionnaire in writing at the PACU. The inclusion of patients was done within the first hours after surgery. Patients' demographic and surgical details were retrieved from the Electronic Patient Dossier. All data were stored in a Good Clinical Practice compliant database.

2.4. Sample size and statistical analysis

The previous studies done by Yeung et al. [15] and Welchman et al. [16] did not provide data to be able to calculate a sample size. And, since this is an explorative study lacking inferential statistics, we could not perform a sample size analysis. Due to the COVID-19 period, we could only include patients for a period of one month, from November 11th until December 8th 2020.

Categorical data are presented as frequency and percentage. Continuous data are presented as mean with standard deviation or

median with interquartile range, depending on the distribution of the data. Data from the MTPRT questionnaire were processed by the calculation methods described by de Bruijn et al. [19]. Non-parametric continuous differences in MTPRT liking scores were analysed using the Kruskal–Wallis test. Additionally, a Mann–Whitney U test was performed to determine the location of differences, with the use of a Bonferroni correction for multiple testing. Given the eight different liking items, an adjusted p-value of < 0.00179 was deemed statistically significant following the application of the Bonferroni correction.

3. Results

3.1. Study population

The study flowchart is shown in Fig. 1. In this study a total of 374 surgical patients were screened for eligibility of which 185 patients did not meet the inclusion criteria, and another 132 patients were excluded mostly due to the postponement or cancellation of their surgical procedures. Finally, we included 57 patients in our study. Due to technical difficulties with the iPad, 47 of the 57 patients were able to complete the online MTPRT questionnaire. The additional questions about food characteristics were filled in by 56 of the 57 patients, since one patient did not want to fill in the additional questions due to fatigue after completing the online MTPRT questionnaire.

Baseline patient characteristics are shown in Table 1. There were slightly more female than male patients, and the majority of the patients were middle-aged and non-smoking. The median preoperative fasting time of our patients was almost 15 h. More than half

of the patients underwent either a general surgical procedure or an orthopaedic procedure.

3.2. Primary outcome

In Fig. 2 the MTPRT liking data showed that postoperative patients in the PACU liked low-energy products with a sweet taste the most (median score: 60, IQR [41–76]). The least liked categories were high-carbohydrate products with a savoury taste (31 [15–56]), high-protein products with a savoury taste (33 [23–60]) and high-fat products with a sweet taste (35 [16–51]). But, also high-carbohydrate products with a sweet taste (41 [20–62]), high-fat with a savoury taste (41 [19–63]), high-protein with a sweet taste (37 [18–57]), and low-energy products with a savoury taste (42 [22–54]) had a median score lower than 50 and were therefore not really liked by our patients in the first hours after surgery. Multiple comparison testing for differences between groups showed that low-energy food products with a sweet taste were preferred in each comparison.

In Table 2 the MTPRT ranking data are shown. In the ranking part, all 4 macronutrient categories were simultaneously evaluated in comparison to each other. And, to gain the results of the 4 macronutrient categories, both savoury and sweet products were combined per macronutrient. With this in mind, the ranking results showed that our postoperative patients preferred high-carbohydrate (3.0 [2.0–3.0]), as well as low-energy (2.7 [2.3–3.6]), and high-fat (2.6 [2.3–2.8]) food products, while high-protein products were least preferred (2.1 [1.6–2.6]). Besides the high-protein products, which seem to be ranked latest or almost latest, products from the 3 other macronutrients were ranked more inconsistently making them relatively similarly preferred. Most

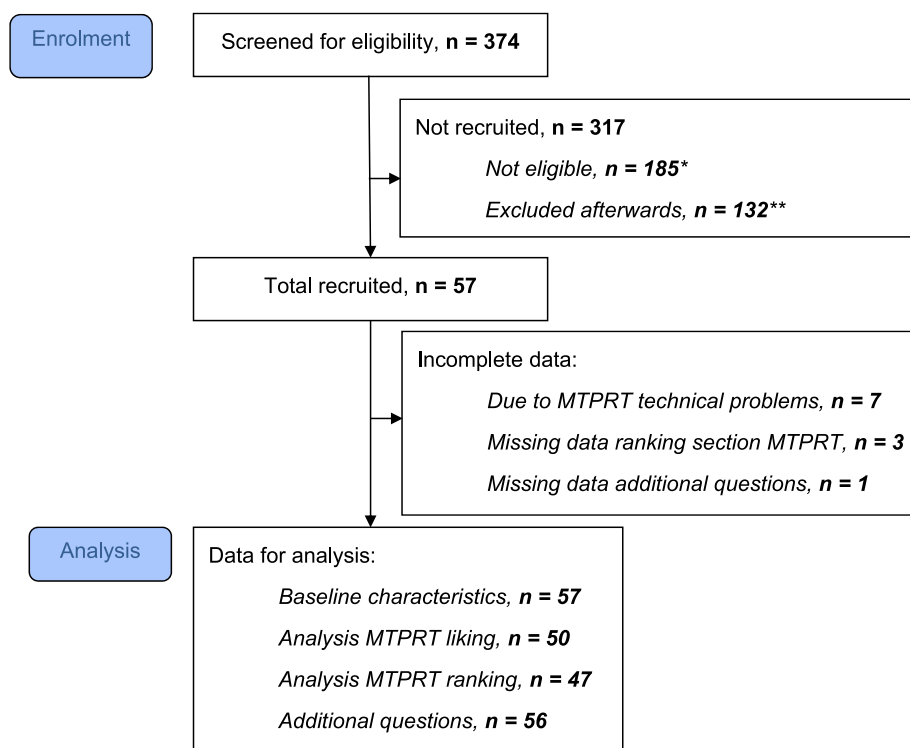


Fig. 1. Study flowchart. *Participants were not eligible for the study due to exclusion criteria. **Patients who had given consent but were excluded due to cancellation of the surgical procedure, delays in their operation, or withdrawal of their consent. MTPRT = the Macronutrient and Taste Preference Ranking Task.

Table 1
Baseline patient characteristics.

	N = 57
Female, n (%)	32 (56 %)
Age, in years, median [IQR]	53 [31–65]
Anthropometrics, median [IQR]	
Height, meters	1.71 [1.65–1.83]
Weight, kilograms	76.4 [70.2–91.5]
BMI ^a , kg/m ²	25.5 [23.4–30.1]
Smoking status, n (%)	
Current	5 (8.8)
Former	14 (24.6)
Non-smoker	38 (66.7)
Medication use, n (%)	
Anti-hypertensive	5 (8.8)
NSAID's	16 (28.1)
Proton pump inhibitors	22 (38.6)
Other ^b	6 (10.3)
ASA, n (%)	
ASA-I	12 (21.1)
ASA-II	31 (54.4)
ASA-III	14 (26.4)
≥ ASA-IV	0 (.0)
Preoperative fasting time, minutes, median [IQR]	890 [810–1070]
Type of surgery, n (%)	
General	18 (31.6)
Orthopaedic	13 (22.8)
Gynaecologic	10 (17.5)
Nephrology/Urological	8 (14.0)
Miscellaneous ^c	8 (14.0)
Preoperative chemotherapy, n (%)	5 (8.8)
Duration of anaesthesia, in minutes, median [IQR]	142 [84–223]

n = number, categorical variables are presented as number with percentiles, and continuous variables are presented as medians with an interquartile range.

^a Body Mass Index (BMI): weight in kilograms divided by height in meters squared.

^b Other medications contained: antimycotics, antiprotozoal, anti-arrhythmic, hypnotics, oncological medication, oral hypoglycaemic agent.

^c Miscellaneous contains the surgical specialisms: neurosurgery, cardiothoracic surgery, reconstructive surgery, trauma surgery, and ear-nose-throat (ENT) surgery.

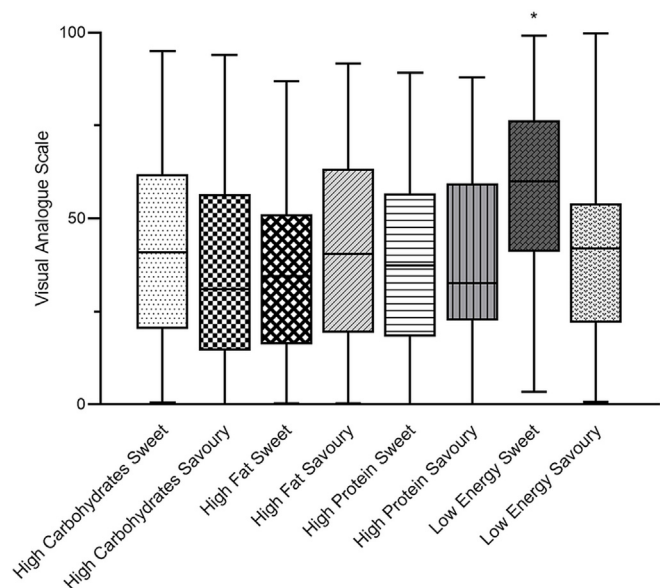


Fig. 2. MTPRT Liking. MTPRT: the Macronutrient and Taste Preference Ranking Task. Liking of 32 different food products were evaluated with a 100 point Visual Analogue Scale (VAS) starting from 'do not like at all' (score 0) to 'like extremely' (score 100). The boxes represent the distributions of the various macronutrients in combination with taste categories, which include the median, interquartile range, and minimum and maximum scores. A symbol (*) is used to indicate a significant difference score. Multiple comparison testing for differences between groups showed that low-energy food products with a sweet taste were preferred in each comparison.

Table 2
MTPRT ranking.

	N = 47
Macronutrients	
Low energy	2.7 [2.3–3.6]
High carbohydrates	3.0 [2.0–3.0]
High fat	2.6 [2.3–2.8]
High protein	2.1 [1.6–2.6]
Taste	
Sweet	2.8 [2.5–3.1]
Umami/Savoury	2.2 [1.9–2.5]

n = number, continuous variables are presented as medians with an interquartile range. The Macronutrient and Taste Preference Ranking Task (MTPRT), ranking section, the macronutrients and taste were divided; the higher the rank, the higher the score (0–4), the higher the preference of a patients. A higher score indicates a higher preference for a macronutrients or taste, with a score over or equal to 2.5 indicating a preference.

patients preferred a sweet taste (2.8 [2.5–3.1]) over a savoury taste (2.2 [1.9–2.5]).

3.3. Secondary outcomes

Data of the additional questionnaire are shown in Table 3, Fig. 3, and Fig. 4. Of the five taste categories, postoperative patients most liked umami/savoury, sweet and salty products (Table 3). Bitter and sour products were least liked. However, we found a broad variation in the interquartile ranges of the scores of all the taste categories, which implies that liking a product differs between patients despite some general consistencies.

Data on the other food characteristics (Table 3, Fig. 3) showed that soft, juicy, hot, and cold food products were liked the most, but crispy food products were also liked. Less favourable food characteristics were dry, creamy, spicy and fizzy. In line with the taste results, the food characteristics results showed a wide variation in the interquartile ranges of the scores.

For appetite (Fig. 4) we found that most postoperative patients reported a moderate appetite level (n = 22, 39 %). Interestingly, the majority of patients had an appetite directly after surgery (n = 44, 79 %), just a minority had no appetite at all (n = 12, 21 %).

Table 3
Food texture and temperature.

	N = 56
Taste	
Sweet	3.0 [2.0–4.0]
Salt	3.0 [2.0–4.0]
Bitter	2.0 [1.0–3.8]
Sour	2.0 [1.0–3.0]
Umami/Savoury	4.0 [2.3–4.0]
Characteristics	
Crispy	3.0 [2.0–4.0]
Soft	4.0 [2.3–4.0]
Juicy	4.0 [3.0–4.0]
Dry	2.0 [1.0–3.0]
Creamy	2.0 [1.0–3.0]
Spicy	2.0 [1.0–3.8]
Fizzy	2.0 [1.0–3.0]
Hot	4.0 [3.0–4.0]
Cold	4.0 [3.0–5.0]
Appetite level	3.0 [2.0–4.0]

N = number, continuous variables are presented as medians with an interquartile range. Scoring of the food characteristics went from 0 (not favourable) to 5 (favourable). Data is derived from the additional questionnaire.

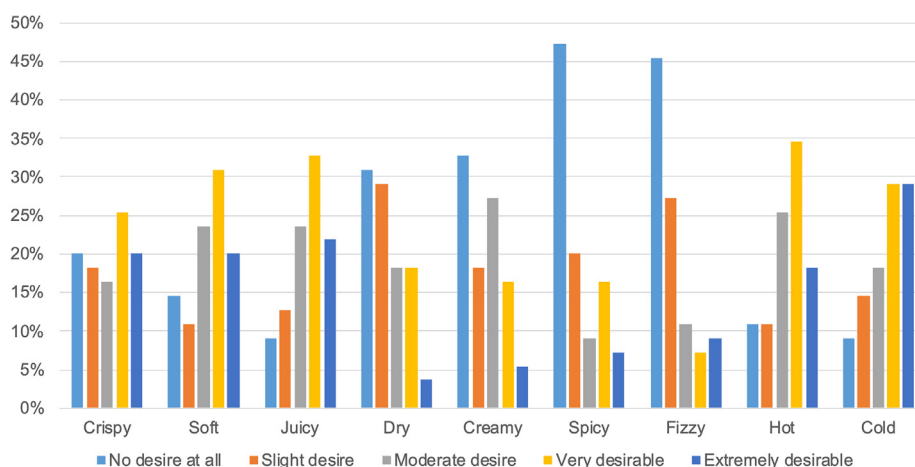


Fig. 3. Food texture and temperature. Scoring (in frequency, %) of the food characterises went from 1 (no desire at all) to 5 (extremely desirable). Data is derived from the additional questionnaire.

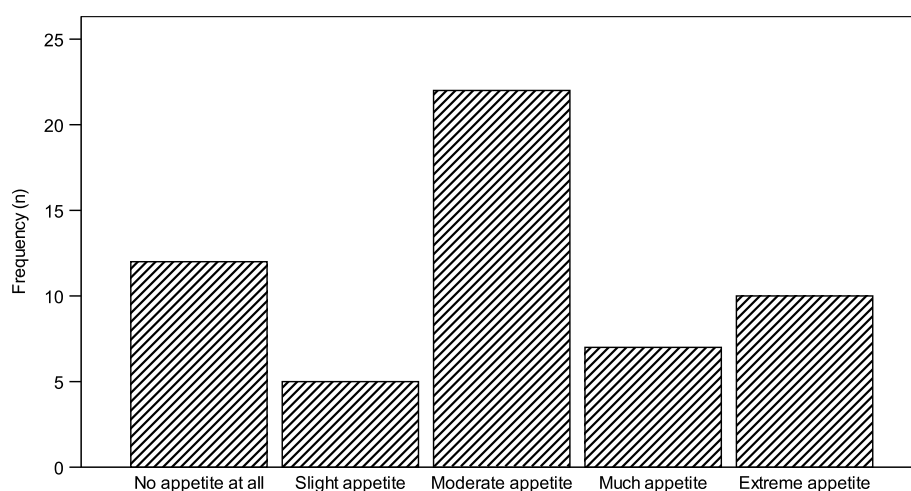


Fig. 4. Appetite level. Scoring of the level of appetite went from 1 (no appetite at all) to 5 (extreme appetite). Data is derived from the additional questionnaire. The data is presented as the frequency at every appetite level. n = number.

4. Discussion

The main finding of our study is that postoperative patients in the PACU like low-energy food products with a sweet taste the most, according to the results of the MRPRT liking. This interest in low-energy food products was unexpected. Just a few studies reported about food and taste preference after surgery [15,16]. Yeung et al. showed in 145 colorectal surgery patients that they preferred solid, simple foods over clear fluids as their first intake after surgery [15]. Welchman et al. showed in 31 colorectal surgery patients that savoury, salty and sweet food products were liked after surgery in the surgical ward [16]. These study results are not in line with the observed preference for low-energy food products. However, combining these study results from the surgical ward with the knowledge that humans in general have an inborn preference towards sweet food products [11], we would expect the outcome of the likeability of the sweet taste. That humans find high-caloric as well as high-fat food products most palatable [12], is an extra argument for not expecting the result of our study for the preference for low-energy food products.

An explanation could be that some of the patients were in a hypophagia state due to the stress of surgery, prolonged

preoperative fasting and/or hospitalisation. Although our patients did report experiencing an appetite according to the additional questionnaire, it is possible that these appetite scores do not reflect preferences towards larger or more caloric meals. It is known that stress can result in an acute stress-induced hypophagia, as showed in a longitudinal study involving 1355 healthy participants. In this study about 40 % of people decreased their calorie intake by around 40 % in stressful situations [20]. Intake in the PACU is directly after surgery, whereas the study results by Yeung et al. [15] and Welchman et al. [16] are from a longer time after surgery at the surgical ward. This time delay between our studies could be the explanation of our observed differences if the hypophagia state due to stress would be an issue.

To positively influence postoperative outcome, there is a strong focus on adequate postoperative protein intake. This is also recommended in the ESPEN guidelines [1]. A reason to promote protein intake is the high prevalence of postoperative malnutrition, affecting over 50 % of postoperative patients [21,22]. The MTPRT liking part results show that our patients did not really like high-protein food products, similar to the results of the high-carbohydrate and the high fat food products (Fig. 2). But, from the MTPRT ranking part, we showed that our postoperative patients

had an aversion towards high-protein products when they had to rank the four different macronutrients. As mentioned in the introduction, the perception of umami/savoury is related to protein content, since umami/savoury products normally contain a higher level of protein [13,14]. Looking at our data on savoury products, we show different results in the questionnaires. In the MTPRT liking part, when patients scored each product separately (Fig. 2), savoury products are slightly less liked compared to the sweets in the high carbohydrate, high protein and the low-energy categories, but are slightly in favour in the high fat category. In the MTPRT ranking part (Table 2), when the patients had to compare four products at a time, savoury products were not preferred over sweet ones. The results of the additional questionnaire showed that a savoury taste is liked (Table 3). The difference might be attributed to the different food products given in the questionnaires. In the additional questionnaire the examples of savoury products were only cheese or broth, compared to sixteen savoury food products in the MTPRT questionnaire. Cheese is included in both, but the broth only in the additional questionnaire. From our experience a cup of broth is liked by most patients at our PACU, since it is e.g. easy to take in. Welchman et al. showed that postoperative colorectal patients in the surgical ward liked savoury (cheese) and sweet (fudge, sugar) food products the most [16].

Our results were inconclusive whether postoperative patients at the PACU did not prefer savoury products. And taken into account the results of Welchman et al. [16] we can try to add savoury food products to a 'PACU-menu'. And via trial-and-error we can find savoury high-protein products, and can have it both ways; having patients eating something they like and at the same time something that enhances their recovery from surgery.

Our study showed a huge variety in what postoperative patients in the PACU like to eat and/or drink. Looking at the interquartile ranges of all the questionnaires, there was not a single food product that was not liked by any postoperative patient. This is in line with what we know about the personal preferences and intake of humans. Humans are examples of food generalists, omnivores, which implies that one wants a diverse diet including almost any substance capable of consuming [23]. It is therefore advised to have a 'PACU-menu' that has a good variety in food products with regard to macronutrients, taste, texture and temperature.

The predominant limitation of our research is the relatively small sample size. Due to the COVID-19 pandemic, fewer patients were included than was expected and the study period only lasted about one month. Not only fewer surgeries were conducted, but surgeries were more often cancelled or postponed. It is uncertain if this population is generalizable to the elective surgical population due to the more selective patient population during the COVID-19 pandemic. Due to the small sample size, the significance testing which was performed in this study may be unreliable.

Taste is a challenging and complex subject to study. We made specific choices regarding the scope and focus of the study. This led to an exploratory design, and a relatively small sample size, making it not feasible to statistically analyse most of the data, as well as testing for possible confounding effects. A confounder could have been the energy content within each macronutrient category. De Bruijn et al. state that the energy content of sweet versus savoury foods may differ in the MTPRT food products [19]. For the MTPRT food products in the high-carbohydrates and the high-fat groups, the savoury items had a higher energy content than the sweet counterparts. However, for the low energy MTPRT food products the sweet items are higher in energy than the savoury counterparts. And, for the high-protein food products, only a small difference is present between the sweet and the savoury items, and all high-protein products are lower in energy than all of the high-carbohydrate and high-fat food products. It is unknown if the

energy differences between savoury and sweet products, ranging between no difference to about 300 kcal, could have led to preference differences in this study. However, energy content cannot fully explain the found differences and liking of low-energy products, e.g. since the high-protein products are less liked than the high-carbohydrate and the high-fat products, but are a lot lower in energy than the high-carbohydrate and the high-fat products.

In addition to energy content, we were limited in studying other known factors that have a role in taste preference, like more textural aspects, cultural aspects, and comorbidities such as diabetes [24–26].

For the MTPRT and the additional questionnaire different food products were chosen. In the additional questionnaire melon and/or wine gums were chosen as a sweet product, but another food product could have been chosen as a sweet product. One patient can like melon and/or wine gums, but another might not, but could have liked another sweet product. Although it is given as a suggestion, patients can take the suggestion literally. Therefore, making a selection of food products could have influenced the answers of our patients, but also might explain the differences between the outcomes of the MTPRT and the additional questionnaire.

A strength of our study is the use of various questionnaire methods to assess taste preference. For instance, in the MTPRT liking part, the high protein products are not really liked. But in the MTPRT ranking part, when patients had to prioritize between macronutrients, high protein products were not preferred. Looking at the high-carbohydrates in the different MTPRT parts, the results might seem conflicting. The MTPRT liking part showed the lowest median for high-carbohydrate savoury food products, whereas the MTPRT ranking part showed a preference for high-carbohydrate food products. However, in the liking part the eight different categories are showed separately and are also scored individually. In the ranking part the results of the four macronutrients were showed, in which the savoury and sweet products are combined per macronutrient. Using different methods helped to gain a more comprehensive understanding of our PACU patients taste preference.

An additional strength of the study is its conduct within the PACU. In the PACU the primary goal of early nutritional care is to reactivate the patient's digestive system, to start up the gastrointestinal tract to work normally again. Back in the ward, the goal of nutritional care is shifted towards facilitating patient recovery. For optimal nutritional care of postoperative patients the PACU and the surgical ward are codependent.

Finally, future studies with larger sample size and/or other food products will show if our results on the taste preferences of postoperative patients can be confirmed. Future studies can explore the role of different food characteristics with regard to the preference of specific macronutrients and taste qualities. And, it would be interesting to study taste preference in postoperative patients for a longer period of time, to be able to evaluate if taste preference alters at different stages of postoperative recovery.

5. Conclusion

Overall, our study provides valuable insights into the taste preferences of postoperative patients in the PACU, using a validated questionnaire which determines both taste and macronutrients preferences. Because multiple aspects define taste preference, we expanded the MTPRT with additional questions. Therefore, we did not only have results about taste and macronutrients, but also gave insight into other important taste experience aspects like texture and temperature.

This study showed that postoperative patients in the PACU tended to like low-energy food products with a sweet taste the most, and did

not seem to prefer high-protein products. In addition, patients directly after surgery seemed to favour a broad variety of food products. This knowledge may help to improve food services in PACU's, and thereby contribute to enhance early postoperative oral intake.

Author contributions

E.S. de Klerk: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Roles/Writing - original draft; M. Koetsier: Investigation; Methodology; Project administration; S.C.M. Rietveld: Methodology; Visualization; Writing - review & editing. S. Boesveldt: Methodology; Resources; Software; Writing - review & editing. E.M. Postma: Resources; Software; Writing - review & editing. P. Morquecho Campos: Methodology; Resources; Software; M.W. Hollmann: Methodology; Visualization; Writing - review & editing. B. Preckel: Methodology; Visualization; Writing - review & editing. J. Hermanides: Methodology; Visualization; Writing - review & editing. M.F.M. van Stijn: Conceptualization, Methodology, Formal analysis, Writing - Original Draft, Visualization, Project administration.

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Declaration of competing interest

The authors have no competing interests to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clnesp.2025.03.047>.

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