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Fasting orders and malnutrition risk in hospitals: The impact of mandatory fasting on hunger perception in nutritionally at-risk patients

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SUMMARY

Background & aims: Hospitalized patients frequently undergo fasting for diagnostic procedures. This study investigated craving and hunger perceptions during fasting and assessed whether oral nutritional supplements (ONS) could alleviate these effects.

Methods: This post-hoc analysis of a randomized prospective study (July 2021–May 2023) included 210 of 215 evaluated patients (of 250 enrolled patients), of whom 30 % (64) were screened as at risk of malnutrition (ARM) according to the Nutritional Risk Score 2002 (NRS). The original study compared three preparation protocols (breakfast, fasting, and ONS) before abdominal ultrasound. The 15-item Food Craving Questionnaire-State (FCQ-S) assessed cravings (items 1–12) and hunger (items 13–15) on a 5-point Likert scale. Secondary outcomes included the effects of the preparation protocols on these scores. Statistical analysis included Welch's t-test, ANOVA with Tukey's post-hoc correction, and two-way ANCOVA (adjusted for age and sex), with Bonferroni correction for multiple comparisons.

Results: ARM patients reported significantly higher FCQ-S Hunger scores than patients screened as not at risk of malnutrition (NARM) (M_{diff} = -1.24, 95 % CI [-2.24, -0.24], $p = 0.016$). This difference was driven by the fasting group, where ARM patients had significantly higher Hunger scores than NARM patients (M_{diff} = -2.88, 95 % CI [-4.51, -1.25], $p < 0.001$). In ARM patients, ONS significantly reduced Craving and Hunger scores, with an effect comparable to breakfast, particularly in hunger perception (ONS vs. Fasting: M_{diff} = -3.83, 95 % CI [-6.13, -1.53], $p < 0.001$; Breakfast vs. Fasting: M_{diff} = -3.78, 95 % CI [-6.07, -1.49], $p < 0.001$). In contrast, NARM patients receiving ONS had similar Hunger scores to those who fasted. ARM status did not adversely affect abdominal ultrasound assessment.

Conclusion: ARM patients experienced greater fasting-related hunger, indicating a disproportionate impact of fasting and suggesting a different adaptation to fasting. ONS could alleviate cravings and hunger, similar to the effects of a breakfast in ARM patients. Reevaluating fasting orders could help mitigate hospital malnutrition effects.

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1. Introduction

Malnutrition in hospitalized patients is a significant global concern, particularly in acute care settings [1]. In Germany, the risk of malnutrition upon hospital admission is approximately 25 % and can be as high as 50 % in specific patient populations [2]. Malnutrition contributes to increased morbidity, complications, prolonged hospital stays, and higher rates of re-admission [3,4]. Fasting orders or "nil per mouth" (NPO) during hospital stays tend to be overused and sometimes lack clear indication [5–8]. Usually, patients following NPO orders begin fasting after the last meal the evening before the procedure, commonly leading to fasting durations exceeding 12 h [7,9–11]. In ARM patients, fasting orders can lead to further health deterioration, disruption of nutritional therapy, and thus increased morbidity, mortality, and healthcare costs [12–14]. Clinical guidelines and recommendations increasingly reconsider strict NPO practices [15] and allow for modifications before specific procedures, such as permitting a light breakfast [16] or lifting any fasting requirements [17,18]. NPO orders are known not only to increase damaging physiological responses in patients [19] but also to worsen the feeling of general discomfort, such as anxiety and nausea [20]. Closely monitoring appropriate fasting decisions in hospitals can be one measure against hospital malnutrition [14,21]. A growing body of research examines malnutrition's physiological and clinical effects [22–26]. However, food cravings and hunger related to malnutrition have been explored less. Research suggests that healthy older adults' craving and hunger responses alter due to metabolic adaptations with aging [27–29]. Acute, acute-on-chronic, and chronic diseases lead to inflammatory changes, causing a shift to energy catabolism [3,26]. A range of chronic disease-related malnutrition [30,31] signifies an adaptation mechanism to the imbalance between active food intake, altered gut-brain signaling, and physiological needs based on complex hormone responses [32–35]. Patients at risk of malnutrition may experience different levels of discomfort due to metabolic and hormonal adaptations, yet these sensations are poorly studied in clinical settings.

This study examined the effects of fasting on cravings and hunger in ARM versus NARM patients. Additionally, we investigated whether alternative protocols, such as liquid ONS, can alleviate these sensations while maintaining diagnostic accuracy in abdominal ultrasound exams.

2. Material & methods

2.1. Original study

At our hospital, a secondary-care hospital in Germany, a randomized prospective examiner-blinded study was conducted between July 6, 2021, and May 17, 2023, investigating the influence of traditional fasting compared to a solid breakfast or a liquid ONS on the quality of a routine abdominal ultrasound examination in hospitalized patients, stratifying for examiners experience. The Berlin Medical Association Ethics Committee (Eth-44/21) approved the study, and it was registered in the German Clinical Study Registry (DRKS-ID: DRKS00025785). The results of the original trial have been published in full [36].

2.2. Original trial design and participants

The original study included adult inpatients from internal medicine (gastroenterology, oncology, and cardiology), dermatology, otorhinology, and neurology departments undergoing elective abdominal ultrasound for indications such as undifferentiated abdominal pain, abnormal laboratory values, suspected neoplasms, or infection. Exclusion criteria were age under 18, lack of informed consent, or need for emergency diagnostics. After signed consent, eligible participants were randomized the afternoon before their ultrasound into one of three intervention groups: breakfast, fasting, and liquid ONS. The hospital breakfast reflected a typical German meal of bread, spreads, and yogurt (approximately 400–600 kcal or 1.670–2.510 kJ), with specific preferences in ordering and actual consumption left unmonitored to simulate real-world conditions. The ONS group received 200 ml of Nutricia preOp (100 kcal/430 kJ) but switched to 200 ml of Fresubin ProvideXtra (300 kcal/1.260 kJ) towards the end of the study due to supply issues. Both fat-free supplements were chosen to minimize gallbladder contractions and were selected to align with the beneficial effects outlined for carbohydrates in the Enhanced Recovery After Surgery (ERAS) recommendations [37]. Breakfast and ONS were served between 06:30 and 08:00 h. The fasting group refrained from eating breakfast in the morning, as instructed the evening prior. Abdominal ultrasounds were performed between 08:00 and 12:00 h. Since hospital dinner was served between 17:00 and 18:00 h, the total fasting time in the fasting group ranged from a minimum of 14 h to a maximum of 18 h. Two examiners independently assessed organ assessability (more details in Supplement 1). An average abdominal ultrasound in our ultrasound department takes about 20–30 min for the above-mentioned indications. After the ultrasound, patients were asked to answer the Food Cravings Questionnaire – State (FCQ-S) to assess cravings and hunger.

2.3. Original randomization, implementation, and blinding

The original study used a decentralized randomization process with sealed envelopes for group allocation, avoiding traditional methods due to frequent staff changes and ward closures during COVID-19. During this time, 88 envelopes were lost and had to be replaced, resulting in unequal group sizes since their contents were unknown. Nevertheless, we believe the missing envelopes were "missing completely at random" and do not expect any bias in group assignments.

The group allocation was communicated in writing and personally to the nursing staff to ensure proper implementation and adherence. Patients were asked to confirm protocol fidelity in a questionnaire after the ultrasound. Blinding was ensured by several measures: doctors responsible for screening were not part of the ultrasound team, and examiners had to record their awareness of the intervention after the ultrasound. Patients were also asked whether they believed the examiner knew their intervention group, ensuring the integrity of the blinding process.

2.4. Sample size and data handling

The sample size was determined according to the original study's focus on assessing the impact of three preparation protocols on organ assessability during ultrasound. For our post-hoc analysis, based on the standard assumption of 64 participants per arm ($N = 128$, $df = 126$), the study is sufficiently powered to detect a medium size effect size ($d = 0.5$) with $\alpha = 0.05$ and power = 0.8. However, our actual sample size ($N1 = 64$, $N2 = 146$) was larger, allowing for better detection of smaller effects. A post-hoc power analysis was conducted.

Data were handled pseudonymously, and no access was granted to original patient data or ultrasound images.

2.5. Post-hoc analysis: outcomes and data collection

The FCQ-S is a validated tool in several languages to assess psychological responses to stress or food abstinence that influence

food cravings [38]. The original 15-item scale represented five dimensions of craving [39]. However, items 1–12, which addressed desire, positive reinforcement, the anticipation of relief, and lack of control, were inconsistent in reproducibility in previous studies [40]. These items were thus combined to derive the FCQ-S Craving score [41]. The reliability of this combination into a single score will be tested in our population with McDonalds Omega. Items 13–15, which interpret craving mainly as a physiological state of hunger [42,43], formed the FCQ-S Hunger score.

Patient baseline characteristics included age, sex, Body Mass Index (BMI), NRS [44], and surgical history. The NRS, which incorporates disease severity, malnutrition indicators (BMI, weight loss, reduced food intake), and age, categorizes patients as being at low risk (scores <3) or at moderate to very high risk (scores ≥3) [45], thus creating a dichotomous nominal scale.

2.6. Post-hoc analysis: statistical methods

Patients with protocol violations or incomplete data were excluded. Differences in FCQ-S means between ARM and NARM patients were analyzed using unpaired t-tests with Welch's correction. Subgroup analyses comparing preparation methods in ARM versus NARM patients also employed unpaired t-tests with Welch's corrections, with significant findings further adjusted via two-way ANCOVAs to adjust for age and sex. One-way ANOVAs examined the effects of three preparation protocols on FCQ-S scores, followed by two-way ANCOVAs to adjust for age and sex. Tukey's post hoc test and Bonferroni correction addressed multiple comparisons. Two-sided p-values <0.05 were considered significant. Internal consistency for the Craving score was measured using McDonald's Omega. All statistical analyses were conducted with SPSS (version 30.0.0.0, IBM Corp.).

3. Results

Between July 6, 2021, and May 17, 2023, 250 patients were screened for participation, with 35 excluded for protocol breaches in the original study and five for not meeting the inclusion criteria for this study (Fig. 1).

Among the 210 included patients, 30 % [64] were screened as ARM (NRS of 3 or higher). The median age was 65 years (18–93), and the median BMI was 25.8 kg/m^2. Patient characteristics stratified for NRS and the three protocols are depicted in Table 1.

3.1. Malnutrition risk and FCQ-S scores

Stratifying the FCQ-S scores for malnutrition risk, we found a mean Hunger score of 7.84 (95 % CI[6.98, 8.71]) in the ARM group, compared to 6.60 (95 % CI[6.09, 7.12]) in the NARM group, with a mean difference of −1.24 points (95 % CI[-2.24, −0.24]), which was statistically significant ($p = 0.016$) (see Table 2). The differences in the mean FCQ-S Total score and the mean FCQ-S Craving score were not statistically significant.

Additionally, we compared the subgroups based on individual preparation methods. The results are presented in Table 3. The total FCQ-S score, as well as the Craving and Hunger scores, were significantly higher in fasting ARM patients compared to fasting NARM patients, with average differences of −9.75 points (95 % CI [−17.50, −2.00]), −6.87 points (95 % CI [−13.26, −0.48]), and −2.88 points (95 % CI [−4.51, −1.25]), respectively. These differences remained significant after adjusting for age and sex. Notably, the FCQ-S Hunger score showed a particularly large effect (partial $\eta^2 = 0.163$, where ≥0.14 indicates a large effect).

In patients receiving ONS and breakfast, there was no statistically significant difference across all scores, adjusted for age and sex, between ARM and NARM patients.

Figure 2 summarizes the results for the FCQ-S Hunger score concerning the preparation protocols.

3.2. FCQ-S scores stratified for preparation protocols

There were significant differences concerning the three preparation methods across all scores in the ARM and NARM patients. After adjusting for age and sex and correcting for multiple testing the significance remained. All scores - independent of malnutrition risk status - showed a significant difference between patients who had breakfast and those who were fasting, with a large effect (effect size partial $\eta^2 \geq 0.14$ = large effect) among ARM patients (Table 4).

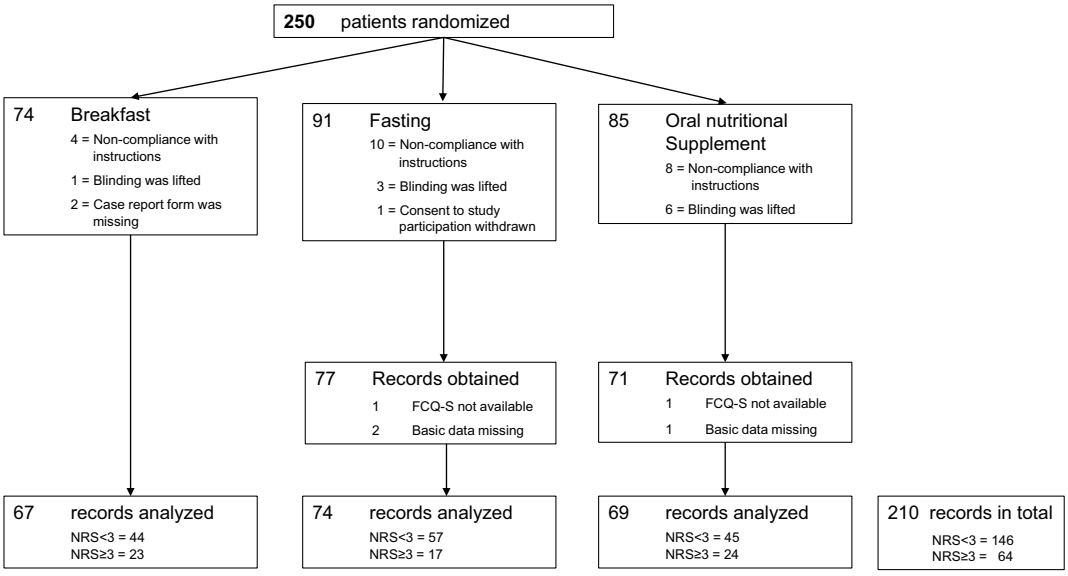

Fig. 1. Patient selection flow diagram.
FCQ-S = Food Cravings Questionnaire–State, NRS = Nutritional Risk Score 2002.

Table 1
Baseline characteristics of study participants.

	NRS ≥3	NRS <3	Total
Number (%)	64 (30)	146 (70)	210 (100)
Median age (range), years	71 (22–93)	61 (18–90)	65 (18–93)
Sex, N (%)			
Female	34 (53)	59 (40)	93 (44)
BMI, median (IQR), kg/m^2	21.3 (19.6–25.0)	27.1 (24.4–30.4)	25.8 (22.6–29.7)
Protocol, N (%)			
Breakfast	23 (36)	44 (30)	67 (32)
Fasting	17 (27)	57 (39)	74 (35)
ONS	24 (37)	45 (31)	69 (33)

NRS = Nutritional Risk Score 2002, NRS <3 = not at risk of malnutrition, NRS ≥3 = at risk of malnutrition, BMI = body mass index, IQA = interquartile range, ONS = oral nutritional supplements.

Table 2
Mean FCQ-S scores of patients stratified for malnutrition risk.

Outcome	NRS ≥3 N = 64 Mean [95 % CI]	NRS <3 N = 146 Mean [95 % CI]	M_{diff} [95 % CI]	*t* (*df*)	*p*	Cohen's *d*
FCQ-S Total	M = 35.77 [32.50, 39.03]	M = 32.14 [30.02, 34.26]	−3.62 [-7.46, 0.02]	−1.852 (119.30)	0.067	−0.279
FCQ-S Craving	M = 27.92 [25.37, 30.48]	M = 25.54 [23.84, 27.24]	−2.38 [-5.43, 0.67]	−1.566 (121.83)	0.125	−0.231
FCQ-S Hunger	M = 7.84 [6.89, 8.71]	M = 6.60 [6.09, 7.12]	−1.24 [-2.24, −0.24]	−2.456 (109.97)	**0.016***	−0.383

Unpaired T-test with Welch's correction. NRS = Nutritional Risk Score 2002, NRS <3 = not at risk of malnutrition, NRS ≥3 = at risk of malnutrition, FCQ-S = Food Craving Questionnaire, M = mean, 95 % CI = 95 % confidence interval, M_{diff} = mean difference, *t*(*df*) = test statistic degrees of freedom, *p* = *p*-value, * *p*-value <0.0**5** is significant, Cohen's *d* = effect size, interpretation: ≥0.20 small effect, ≥0.50 medium effect, ≥0.80 large effect.

Table 3
FCQ-S scores of patients in the fasting group stratified for malnutrition risk.

	NRS ≥3 (N = 17) Mean [95 % CI]	NRS <3 (N = 57) Mean [95 % CI]	M_{diff} [95 % CI]	*F*(*df*)	*p*	Part. η^2
FCQ-S Total	M = 44.65 [37.62, 51.67]	M = 34.89 [31.28, 38.51]	−9.75 [-17.50, −2.00]	*F*(1,70) = 7.293	**0.009***	0.094
FCQ-S Craving	M = 34.29 [28.48, 40.11]	M = 27.42 [24.49, 30.35]	−6.87 [-13.26, −0.48]	*F*(1,70) = 5.319	**0.024***	0.071
FCQ-S Hunger	M = 10.35 [8.91, 11.80]	M = 7.47 [6.64, 8.30]	−2.88 [-4.51, −1,25]	*F*(1,70) = 13.677	**<0.001***	**0.163**

ANCOVA, adjusted for age and sex. NRS = Nutritional Risk Score 2002, NRS <3 = not at risk of malnutrition, NRS ≥3 = at risk of malnutrition, FCQ-S = Food Craving Questionnaire, M = mean, 95 % CI = 95 % confidence interval, M_{diff} = mean difference, *F*(*df*) = ANCOVA degrees of freedom, *p* = *p*-value, part. η^2 = partial η^2, effect size, interpretation: ≥0.01 small effect, ≥0.06 medium effect, ≥0.14 large effect, * *p* <0.05 is significant.

NARM patients differed significantly in the FCQ-S Hunger score when comparing breakfast and ONS ($p = 0.03$, $M_{diff} = -1.676$, 95 % CI[-3.23, −0.12]). Whereas, in ARM patients, all three FCQ-S scores differed significantly with large effects when comparing ONS and Fasting, especially pronounced in the FCQ-S Hunger score ($p < 0.001$, $M_{diff} = -3.828$, 95 % CI[-6.13, −1.53]).

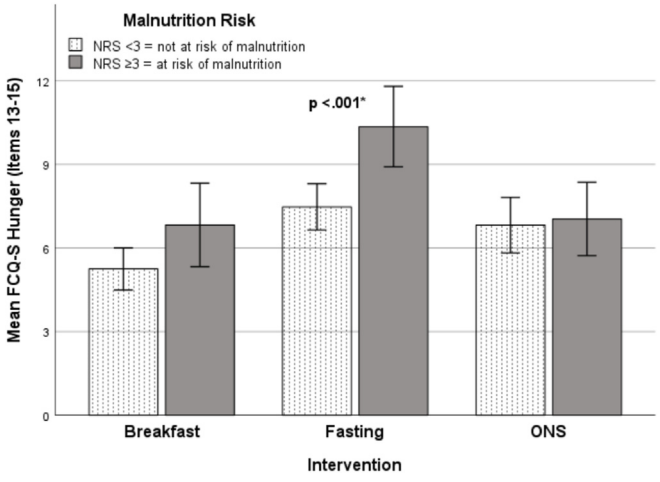

Fig. 2. FCQ-S Hunger score and preparation protocol.
*Mean FCQ-S Hunger score with 95 % Confidence Intervals. FCQ-S = Food Craving Questionnaire, ONS = Oral nutritional supplement, p = p-value, * = p <0.05 is significant.*

3.3. Reliability of the FCQ-S craving score

The reliability analysis of the FCQ-S Craving (items 1–12 combined) in the population of the post-hoc analysis (N = 210) showed excellent consistency, with ω = 0.935 (McDonald's Omega).

Results for the ultrasound assessment, stratified for malnutrition risk, can be found in Supplement 1. ARM status did not adversely affect abdominal ultrasound assessment.

4. Discussion

4.1. Malnutrition risk and FCQ-S scores

Our study found that ARM patients reported significantly higher Hunger scores on the FCQ-S compared to NARM patients. This result challenges the assumption that hunger universally diminishes as a feature of malnutrition or sickness, which has been linked to physiological adaptation theories [26,35,46]. While reduced hunger is reported in hospitalized patients due to factors such as inflammation, metabolic changes, and psychosocial influences [3,24,26,47] - possibly to conserve energy during illness and minimize systemic inflammation [34] - our findings suggest

Table 4
FCQ-S scores across preparation protocols stratified for malnutrition risk.

Group	Subscale	*F*(*df*)	*p*	Part.η^2	Post-hoc results[a]
NRS <3 (N = 146)	FCQ-S Total	*F*(2,141) = 4.838	0.009*	0.064	Breakfast < Fasting *p* = 0.008* M_{diff} = −7.88, 95 % CI[-14.16, −1.60]
	FCQ-S Craving	*F*(2,141) = 3.684	0.028*	0.050	Breakfast < Fasting *p* = 0.027* M_{diff} = −5.52, 95 % CI[-1.58, −0.46]
	FCQ-S Hunger	*F*(2,141) = 7.596	<0.001*	0.097	Breakfast < Fasting *p* <0.001* M_{diff} = −2.36, 95 % CI[-3.84, −0.87] Breakfast < ONS *p* = 0.03* M_{diff} = −1.676, 95 % CI[-3.23, -0.12]
NRS ≥3 (N = 64)	FCQ-S Total	*F*(2, 59) = 7.510	0.001*	**0.203**	Breakfast < Fasting *p* = 0.003* M_{diff} = −13.083, 95 % CI[-22.39, -3.78] ONS < Fasting *p* = 0.003* M_{diff} = −13.00, 95 % CI[-22.36, -3.64]
	FCQ-S Craving	*F*(2, 59) = 5.757	0.005*	**0.163**	Breakfast < Fasting *p* = 0.010* M_{diff} = −9.30, 95 % CI[-16.83, −1.77] ONS < Fasting *p* = 0.012* M_{diff} = −9.170, 95 % CI[-16.74, −1.60]
	FCQ-S Hunger	*F*(2, 59) = 10.560	<0.001*	**0.264**	Breakfast < Fasting *p* <0.001* M_{diff} = −3.781, 95 % CI[-6.07, −1.49] ONS < Fasting *p* < 0.001* M_{diff} = −3.828, 95 % CI[-6.13, −1.53]

ANCOVA, adjusted for age and sex. NRS = Nutritional Risk Score 2002, NRS <3 = not at risk of malnutrition, NRS ≥3 = at risk of malnutrition, FCQ-S = Food Craving Questionnaire, ONS = oral nutritional supplement, *F*(*df*) = ANCOVA degrees of freedom, *p* = *p*-value, * *p* < 0.0**5** is significant, part. η^2 = partial η^2, effect size, interpretation: ≥0.01 small effect, ≥0.06 medium effect, ≥ 0.14 large effect, 95 % CI = 95 % confidence interval.
[a] Bonferroni correction.

that hunger may be more pronounced in ARM individuals, particularly during fasting.

The fasting subgroup primarily drove the higher Hunger scores in ARM patients. Hunger, regulated by mechanisms such as the gastric accommodation reflex, typically intensifies during fasting as the stomach remains empty [48], so both groups should be equally affected. In ARM patients already in an energy deficit, fasting likely exacerbates hunger due to limited energy reserves and possibly alters the metabolic equilibrium maintained in malnutrition. Stress-related mechanisms and psychological factors may also increase hunger perception [49]. Although this interpretation is speculative, as our study did not measure metabolic responses or other stressors during fasting. However, different adaptation to fasting between ARM and NARM individuals may be assumed.

Interestingly, while hunger was elevated in ARM patients, there were no significant differences in the overall FCQ-S Total or Craving scores. This suggests that increased hunger does not necessarily correlate with aggravated food cravings or psychological discomfort, reinforcing the distinction between hunger as a physiological need and cravings more influenced by emotional and psychological factors [40,50].

4.2. FCQ-S scores stratified for preparation protocols

In ARM patients, liquid ONS significantly reduced hunger compared to fasting, mimicking the effect of a complete breakfast. This response contrasts with NARM patients, whose Hunger scores with ONS were closer to the fasting Hunger scores. This finding suggests that ONS can be a meal substitute for ARM individuals beyond providing caloric intake to fulfill basic metabolic and gastrointestinal needs. Moreover, it has been shown that ONS can significantly increase energy and protein intake in ARM patients without reducing regular food consumption [51]. The beneficial short-term effects of liquid ONS have been widely discussed in the literature, especially on patients' comfort [52–55], but also as part of the therapeutic concept addressing malnutrition [56,57] with a significant reduction of length of hospital stay [58], complication rate [59], and even mortality [60]. Liquid ONS are recommended already as part of the ERAS recommendations [37] and are part of several nutritional guidelines [57,61].

4.3. Ultrasound assessment

In our study, malnutrition risk did not impair abdominal ultrasound assessment (details in Supplement 1); visual quality was significantly better in ARM patients. This improvement may be attributable to lower BMI and reduced fat layers, which enhance the visibility of abdominal structures [62,63].

4.4. Strengths and limitations

To our knowledge, this study is the first to use the FCQ-S to explore hunger and food cravings in hospitalized patients, particularly in ARM patients. It addresses an important gap by investigating the effects of malnutrition risk on food cravings and hunger using the validated FCQ-S tool. By analyzing the Hunger and Craving scores separately, we gained insights into appetite regulation in ARM patients. The Craving score showed good internal consistency, as evidenced by McDonald's Omega, confirming the reliability of items 1–12 in measuring the same construct. Furthermore, including fasting patients allowed for assessing the effects of caloric restriction on subjective cravings and hunger across different nutritional statuses. The statistical methods used were robust, incorporating effect size measurements and

adjustments for age and sex to account for potential confounders, as well as corrections to address multiple comparisons.

The primary limitation of this post-hoc analysis is its retrospective design, which may limit generalizability. However, the study population represents a typical hospital population from general wards, making the findings relevant to similar settings. Randomization was originally implemented for a different research purpose rather than specifically for malnutrition risk, potentially introducing bias due to lack of stratification.

Another limitation relates to data availability and study design constraints. Diagnoses and comorbidities were not accounted for, as pseudonymization prevented us from exploration of potential biases related to underlying health conditions. Lifting pseudonymization was not covered by the ethical approval, restricting deeper analyses.

The FCQ-S, while validated, has not been previously used in this particular population – older hospitalized patients. Other validated scores, such as the Council on Nutrition Appetite Questionnaire (CNAQ) [64], assess chronic appetite decline in malnourished patients, but we aimed to capture fasting-induced cravings and hunger perception. The FCQ-S, designed to assess momentary, state-dependent perceptions of hunger and cravings, includes both psychological and physiological aspects of hunger. However, prior research suggests inconsistent relationships between FCQ-S scores and food intake. For example, in overweight individuals, FCQ-S scores did not predict food intake [42], while in elderly diabetic outpatients, higher craving scores were associated with increased food consumption [65]. For a baseline assessment of discomfort, a second measurement point such as in the evening before fasting, would have been beneficial, but was not of interest in the original study design.

There were also minor methodological limitations related to fasting. The fasting durations and breakfast contents were not standardized, introducing variability, although this reflects real-world conditions. A further consideration is the potential bias introduced by differences in ONS. While all ONS contained calories and were intended as benefiting via the carbohydrate metabolism as outlined by the ERAS recommendations, variations in caloric content could have affected hunger differently.

Ultrasound scheduling resulted in fasting durations ranging from 14 to 18 h in the fasting group and from 1 to 5 h in the breakfast/ONS groups. We do not believe that the slight variation in ultrasound duration (20–30 min across groups) had a meaningful impact, given the significantly different fasting durations. Nevertheless, these conditions reflect real-world outpatient practice.

Furthermore, we did not control for BMI, as it was already included in the NRS classification. Additionally, we did not account for the severity of illness, even though the NRS classification covers both acute and chronic conditions that could have varying impacts on hunger and cravings. Other factors such as psychological conditions, physical activity, and appetite-altering medications were also not explicitly controlled for [47,66,67].

A post-hoc power analysis of the Hunger score ($d = 0.35$) indicated that detecting this effect size would require approximately 304 participants, suggesting that our study was slightly underpowered but still within a reasonable range. Future studies with larger sample sizes may help clarify smaller effects.

However, our study maintained high data quality, with a moderate dropout rate of 16 %, primarily due to strict protocol adherence.

Despite these limitations, the results of our study likely have broader applicability to procedures requiring fasting in hospitals beyond abdominal ultrasounds. Fasting orders should be applied thoughtfully and restricted to the shortest duration necessary. When fluid intake instead of strict NPO is clinically appropriate, liquid ONS could be a strategy to alleviate discomfort and hunger in patients at risk of malnutrition.

5. Conclusion

This study highlights the impact of fasting on patient comfort, particularly in hospitalized patients at risk of malnutrition on general medicine wards, and stresses the need to minimize fasting durations. Liquid oral nutritional supplements (ONS) can alleviate discomfort in instances where solid fasting is required. Revisiting fasting protocols and validating our findings in outpatient settings and other vulnerable patient populations are essential next steps.

Author contribution

TB: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft**; IH:** Conceptualization, Methodology, Data curation; **UW:** Data curation, Formal analysis**; MS, HT, ML:** Investigation; **MP:** Supervision**; All:** Writing - review & editing.

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Declaration of competing interest

All authors declare no conflict of interest.

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During the preparation of this work the authors used ChatGPT in order to help with structured writing, language accuracy and flow. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

OpenAI. (2024). ChatGPT (Dec 5 version) [Large language model]. Retrieved December 5, 2024, from https://chat.openai.com.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2025.05.003.

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