



## Nutrition/Metabolism

## Fasting habits over a 10-year period: An observational study on adherence to preoperative fasting and postoperative restoration of oral intake in 2 Dutch hospitals



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## ABSTRACT

**Background:** Since 1999, international guidelines recommend fasting from solid foods up to 6 hours and clear liquids up to 2 hours before surgery. Early recovery after surgery programs recommend restoration of oral intake as soon as possible. This study determines adherence to these guidelines up to 20 years after its introduction.

**Methods:** A 2-center observational study with a 10-year interval was performed in the Netherlands. In period 1 (2009), preoperative fasting time was observed as primary outcome. In period 2 (2019), preoperative fasting and postoperative restoration of oral intake were observed. Fasting times were collected using an interview-assisted questionnaire.

**Results:** During both periods, 311 patients were included from vascular, trauma, orthopedic, urological, oncological, gastrointestinal, and ear-nose-throat and maxillary surgical units.

Duration of preoperative fasting was prolonged in 290 (90.3%) patients for solid foods and in 208 (67.8%) patients for clear liquids. Median duration of preoperative fasting from solid foods and clear liquids was respectively 2.5 and 3 times the recommended 6 and 2 hours, with no improvements from one period to another. Postoperative food intake was resumed within 4 hours in 30.7% of the patients. Median duration of perioperative fasting was 23:46 hours (interquartile range 20:00–30:30 hours) for solid foods and 11:00 hours (interquartile range 7:53–16:00 hours) for clear liquids.

**Conclusion:** Old habits die hard. Despite 20 years of fasting guidelines, surgical patients are still exposed erroneously to prolonged fasting in 2 hospitals. Patients should be encouraged to eat and drink until 6 and 2 hours, respectively, before surgery and to restart eating after surgery.

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## Introduction

Nutrition in the perioperative period is important for optimal metabolic response and successful recovery.<sup>1</sup> Many perioperative programs and guidelines therefore incorporate optimization of preoperative nutritional status. During the preoperative period, the nutritional focus in prehabilitation programs<sup>2–5</sup> is to provide

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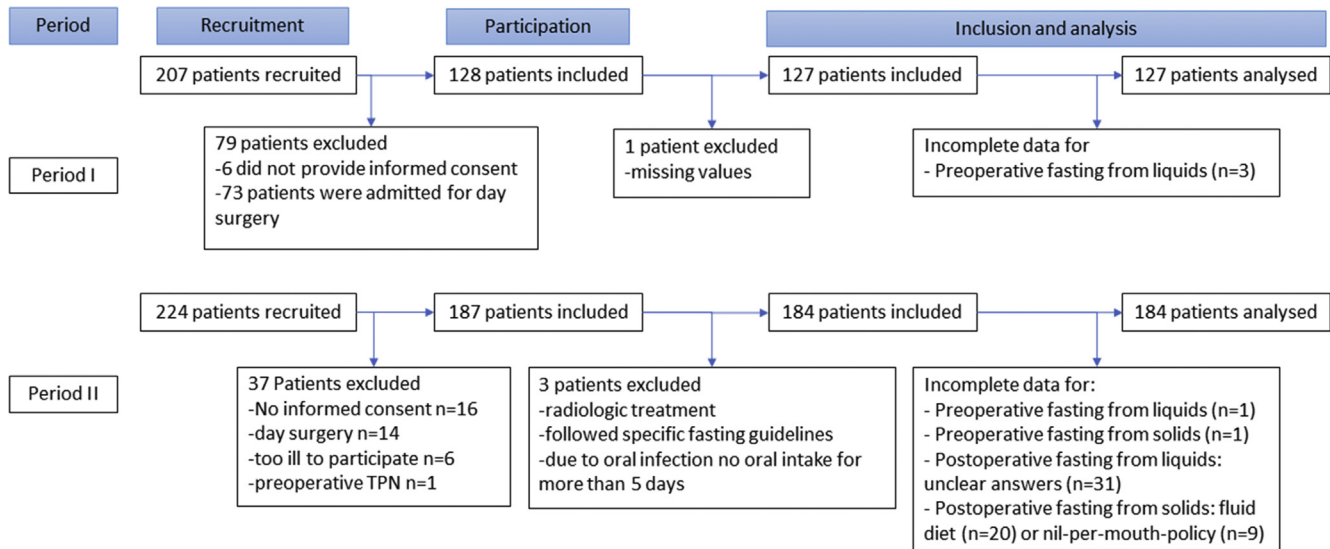


Fig 1. Flow of patients during recruitment, participation, inclusion, and analysis during both periods.

nutritional support for undernourished patients to meet individual nutrient requirements. Preoperative fasting from solids and liquids is mandatory to prevent gastric content causing pulmonary aspiration during anesthesia.<sup>6–8</sup> Sufficient preoperative fasting behavior is defined as abstaining from solid foods for 6 hours and from clear liquids for 2 hours.<sup>8,9</sup> As such, in the direct preoperative phase, there is a competing interest between preventing aspiration and optimizing the metabolic condition.

After surgery, oral nutritional intake should be restored as soon as possible. Enhanced recovery after surgery (ERAS) programs incorporate nutritional recommendations and ensure improved recovery with less complications, shorter hospital stay, and lower hospital costs.<sup>10</sup> These recommendations include early restoration of oral intake,<sup>1</sup> preferably within 4 hours.<sup>11</sup>

Adherence to these perioperative recommendations is difficult for both patients and health care professionals. Studies have demonstrated that fasting periods are unnecessarily prolonged in American, German, and South African hospitals.<sup>12–14</sup> A common reason for this delay is that health care professionals still prescribe to start fasting from midnight. Other barriers for adherence to the guidelines are “low flexibility in operation room management” and “increased risk of aspiration.”<sup>13</sup> Culture change, poor communication and collaboration, and patient characteristics also hinder the implementation of and optimal compliance to ERAS programs.<sup>15</sup> In practice, it may take years to successfully embed an optimal and sustainable perioperative nutritional program.<sup>15,16</sup>

This paper determines adherence to perioperative fasting guidelines from solid foods and clear liquids and to ERAS guidelines regarding resumption of oral intake in 2 Dutch hospitals. Measurements were conducted twice, with a decade in between.

## Methods

Data from 2 prospective observation periods were analyzed to describe adherence to nutritional perioperative recommendations and to investigate the effect of time on adherence. We used the Strengthening the Reporting of Observational studies in Epidemiology statement for transparent reporting.<sup>17</sup>

### Setting

Adherence to perioperative fasting guidelines was evaluated in 1 university hospital (site A; 5 surgical wards) and 1 university-

affiliated teaching hospital (site B; 3 surgical wards) in The Netherlands. Patients were preoperatively informed about the upcoming surgery, including recommendations about fasting. This information was provided both in spoken form (eg, from the nurse, surgeon, and anesthesiologist) and in written form (eg, leaflets). Data were collected in 2 separate time periods with a 10-year interval (ie, period 1: between 2009 and 2011 and period 2: between 2018 and 2019; Fig 1).

### Participants

Patients undergoing surgery were invited for participation if they were at least 18 years old, able to communicate in Dutch or English, and admitted to the vascular, trauma, orthopedic, urological, oncological, gastrointestinal, or ear-nose-throat and maxillary surgical units. Both elective and acute patients were recruited. Patients with a hospital stay of less than 24 hours were excluded. During period 1 at site B, only patients who were scheduled for elective surgery were included.

### Variables and data sources

Primary outcomes were (1) adherence to the guidelines on preoperative fasting, (2) restoration of oral intake, and (3) total perioperative fasting time.

### Adherence to preoperative fasting

Duration of preoperative fasting, adequate adherence, any delay of the scheduled starting time of the procedure, and patients' awareness of the guidelines were measured to determine adherence to the preoperative fasting guideline.

During period 1, data on duration of preoperative fasting were gathered as part of evidence-based quality improvement projects in both hospitals. Data collection periods covered 3 consecutive weeks. During period 2, data on pre, post, and perioperative fasting time, delay of the scheduled starting time of the procedure, and patient's awareness of the guidelines were collected in both hospitals. Data collection covered 4 consecutive weeks.

Duration of preoperative fasting was defined as the time interval between consumption of the last meal or drink before surgery and the introduction of anesthesia. The time of the last consumption of solid foods and clear liquids was provided by the patients

themselves in the holding 10 to 30 minutes before surgery ( $n = 72$ ; 23%; period 1 site B) or on the first day after surgery ( $n = 239$ ; 77%).

During the data collection in period 2, the delay of the scheduled starting time of the procedure and patients' awareness of the guidelines were also measured. To determine delay in operation time, the scheduled operation time communicated with the patient was confirmed by the starting time of the procedure. Patients' awareness of the fasting guidelines was determined using a structured questionnaire ([Supplementary File S1](#)).

#### *Adherence to restore oral intake*

Adherence to the guideline regarding restoration of oral intake was measured by the duration of postoperative fasting and was recorded during period 2. Duration of postoperative fasting was estimated by the time interval between the end of the surgical procedure according to the patients' records and the patients' first consumption of solid foods and clear liquids after surgery. Abstaining 4 hours for solid foods<sup>18</sup> and 2 hours for clear liquids was defined as adequate for postoperative resumption of oral intake.

#### *Perioperative fasting*

Duration of perioperative fasting was defined as the time between the last consumptions before surgery and the first consumptions after surgery.

#### *Baseline characteristics*

The following patient characteristics were collected from the patients' digital records: sex, age, American Society of Anesthesiologists Physical Status Classification,<sup>19</sup> surgical treatment, urgency of surgery (ie, elective or acute), time of surgery (ie, morning or afternoon), and duration of surgical procedure.

#### *Ethical considerations*

Informed consent was obtained from all patients. In period 1, patients provided verbal informed consent for participation and anonymous collection of data. In period 2, privacy requirements were changed. Ethical approval was obtained from the local ethics review committees of both hospitals (site A reference number W19-177 and site B reference number 1804-074). Patients at both hospital sites were eligible for participation if they provided verbal and written informed consents.

#### *Statistical methods*

Descriptive statistics were used to describe patients' characteristics and fasting times. For continuous data with a normal distribution, means were presented with their standard deviations. Medians with their interquartile ranges (IQRs, ie, 25th and 75th percentiles) were presented when data were not normally distributed. The Kolmogorov-Smirnov test was performed to assess normality of data.<sup>20</sup> Consecutively, summary estimates were calculated. For continuous outcome measurements with a normal distribution, mean differences were calculated with a 95% confidence interval (95% CI). If data were not normally distributed, we used the Mann-Whitney test to analyze significant differences between study groups. For dichotomous outcome measurements, the absolute differences were determined with a 95% CI. Fasting duration was described in hours and minutes (ie, XX:XX hours). In our analysis, 8 hours for solid foods and 3 hours for clear liquids were defined as adequate adherence to preoperative fasting guidelines. This is longer than the recommended 6 hours and 2 hours to correct for possible measurement errors. We also opted for

this because ensuring exactly 6 hours and 2 hours may not be feasible due to clinical activities in daily practice. Adherence was reported as numbers and percentages and was categorized into adequate (ie, category A) or inadequate fasting times (ie, categories B, C, and D). All analyses were performed using IBM SPSS, version 25.0, (IBM Corp, Armonk, NY).

## **Results**

### *Participants*

A total of 410 patients were recruited from both hospitals in both time periods. Of these patients, 99 were excluded, mostly because of an expected hospital stay less than 24 hours ( $n = 87$ ; 21%) or no informed consent ( $n = 6$ ; 1.5%) ([Fig 1](#)). Of the remaining 311 patients, 127 (40.9%) underwent surgery in period 1, whereas 184 (59.1%) underwent surgery in period 2. The total sample had a mean age of 58 years (standard deviation 18), and 161 (51.9%) patients were female. Most patients underwent gastrointestinal ( $n = 72$ ; 23.2%) or orthopedic surgery ( $n = 60$ ; 19.3%) ([Table I](#)). Patients included during period 2 were 7.2 years older than patients in period 1 (95% CI 3–11 years). Furthermore, the duration of surgical procedures increased, with 1:22 hours between both periods (95% CI 1:06–1:38 hours) ([Table I](#)). Delay of operation time, as observed during period 2, occurred in 41 cases (22%).

### *Adherence to preoperative fasting*

#### *Fasting from solid foods*

Duration of fasting from solid foods was prolonged in 280 (90.3%) patients. The median duration for fasting from solid foods was 15:19 hours (IQR 13:00–18:19 hours), which is about 2.5 times longer than the recommended 6 hours ([Table II](#)). As noted in [Fig 2](#), 1 out of 4 patients fasted for more than 18 hours (category D;  $n = 81$ ; 26.1%).

#### *Period 1 versus period 2*

No improvement was observed in adequate adherence for period 2 compared with period 1 (period 1:  $n = 18$  out of 127; 14.2%; period 2:  $n = 12$  out of 183; 6.5%). Moreover, adequate adherence to fasting from solid foods was 7.6% lower in period 2 (95% CI 6.9–8.3%) ([Fig 2](#)). Median duration of fasting from solid foods was 16:00 hours (IQR 13:15–18:20 hours) during period 1 and 14:51 hours (IQR 12:50–18:18 hours) during period 2. This difference was not statistically significant based on the Mann-Whitney test ( $P = .41$ ).

During period 2, it was found that patients who were scheduled between 8:00 and 9:00 am fasted significantly shorter compared with patients who underwent surgery after 9:00 am ([Table II](#)). No significant differences were found between morning, afternoon, or evening/night surgery.

#### *Fasting from clear liquids*

Duration of fasting from clear liquids was prolonged in 208 (67.8%) patients and was adequate in 99 (32.2%) patients. The median duration for preoperative fasting from clear liquids was 5:15 hours (IQR 2:25–11:26 hours), which is about 2.5 times longer than the recommended 2 hours ([Table II](#)). One out of 5 patients from both periods ( $n = 64$ ; 20.8%) fasted longer than 12 hours from clear liquids ([Fig 2](#)). Detailed fasting times and adherence per surgical specialty are illustrated in [Supplementary File S2](#).

**Table I**  
Patient characteristics

	Total N = 311	Period 1 n = 127	Period 2 n = 184
Female sex*	161 (51.9)	67 (53.2)	94 (51.1)
Age <sup>†</sup>	58 (18)	54 (20)	61 (17) <sup>‡</sup>
Urgency of surgery*			
Elective	258 (83.2)	119 (94.4)	139 (75.5) <sup>  </sup>
Emergency	52 (16.8)	7 (5.6)	45 (24.5)
Surgical treatment* <sup>‡</sup>			
Vascular	41 (13.2)	8 (6.3)	33 (17.9)
Trauma	34 (10.9)	6 (4.7)	28 (15.2)
Gynecologic	21 (6.8)	8 (6.3)	13 (7.1)
Oncologic	20 (6.4)	-	20 (10.9)
Gastroenterology	72 (23.2)	29 (22.8)	43 (23.4)
Orthopedic	60 (19.3)	34 (26.8)	26 (14.1)
ENT and maxillary	16 (5.1)	12 (9.4)	4 (2.2)
Urology	31 (10.0)	16 (12.6)	15 (8.2)
Plastic surgery	16 (5.1)	14 (11.0)	2 (1.1)
ASA PS Classification* <sup>§</sup>			
ASA 1	60 (24.0)	29 (42.6)	31 (17.0)
ASA 2	110 (44.0)	32 (47.1)	78 (42.9)
ASA 3	69 (27.6)	7 (10.3)	62 (34.1)
ASA 4	11 (4.4)	-	11 (6.0)
Duration of surgical procedure (min) <sup>  </sup>	117 (95)	57 (28)	139 (101) <sup>¶</sup>

ASA, American Society of Anesthesiologists; ENT, ear-nose-throat; SD, standard deviation.

\* Results are expressed as numbers of patients per group (percentages).

<sup>†</sup> Results are expressed as means  $\pm$  SD.

<sup>‡</sup> Some patients underwent surgical treatment for more than 1 option.

<sup>§</sup> Data were not gathered in hospital A during period 1.

<sup>||</sup> P value < .05.

<sup>¶</sup> P value < .001.

**Table II**  
Time of preoperative fasting from clear liquids and solid foods

	Fasting from clear liquids				Fasting from solid foods			
	n	IQR*			n	IQR*		
		25th	Median	75th		25th	Median	75th
Study population <sup>‡</sup>	307	2:25	05:15	11:26	310	13:00	15:19	18:19
Period 1	124	2:10	05:00 <sup>§</sup>	11:30	127	13:15	16:00 <sup>  </sup>	18:20
Urgency of surgery								
Elective	116	2:10	4:23	10:55	119	13:15	15:75	18:20
Emergency	7	3:00	11:45	16:00	7	11:45	16:00	16:45
Time of surgery <sup>†</sup>								
Morning	41	1:50	3:10	10:08	42	15:19	16:00	18:32
Afternoon	29	1:53	2:40	4:45	30	6:24	16:33	19:23
Period 2	183	2:29	05:23 <sup>§</sup>	11:21	183	12:50	14:51 <sup>  </sup>	18:18
Urgency of surgery								
Elective	138	2:07	05:25	10:40	138	12:45	14:30	16:58
Emergency	45	3:18	05:07	13:41	45	13:10	16:39	29:23
Time of surgery								
Morning	97	2:09	07:12	11:29	97	12:54	14:25	16:30
Afternoon	74	2:52	05:06	10:40	74	13:05	16:19	19:00
Evening-night	11	3:55	04:56	08:31	11	11:50	13:56	18:18
Start of surgery								
8:00–9:00 AM	61	1:59	3:25 <sup>¶</sup>	10:26	61	12:37	13:55 <sup>**</sup>	14:33
9:00–8:00 AM	123	3:16	5:35	12:00	122	13:02	16:04	18:59

IQR, interquartile range.

\* HH:MM are hours and minutes.

<sup>†</sup> Data of 1 hospital (B) was available.

<sup>‡</sup> Data of 4 patients were missing for fasting from clear liquids and of 1 patient for fasting from solid foods.

<sup>§</sup> Mann-Whitney test:  $P = .741$ .

<sup>||</sup> Mann-Whitney test:  $P = .410$ .

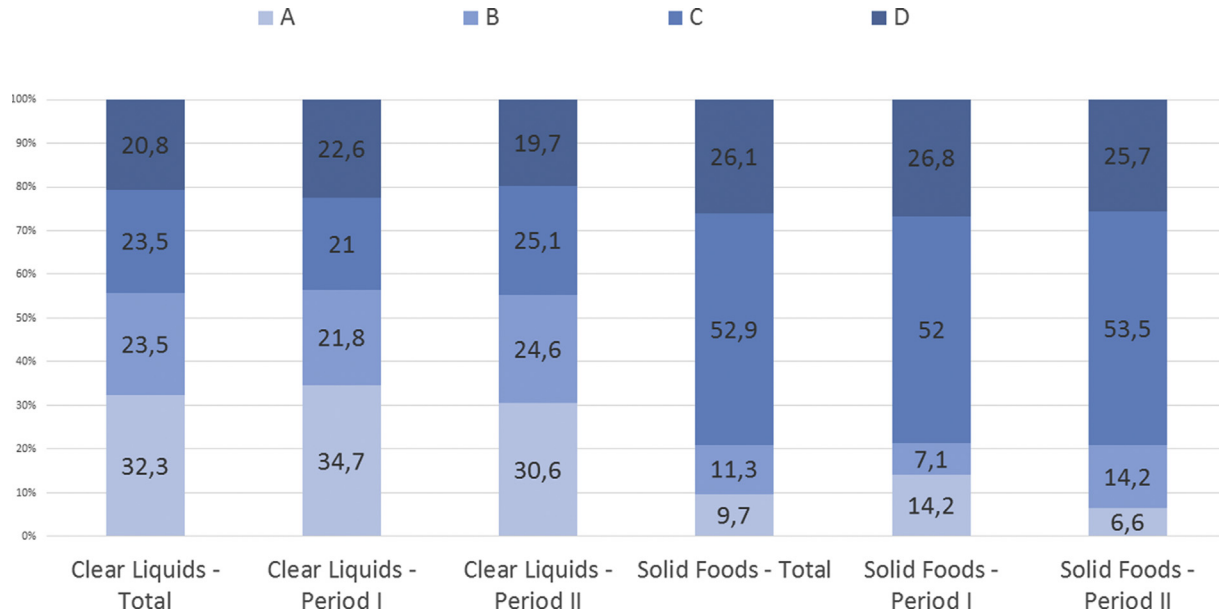
<sup>¶</sup> Mann-Whitney test:  $P = .046$ .

<sup>\*\*</sup> Mann-Whitney test:  $P > .000$ .

### Period 1 versus period 2

Adequate fasting from clear liquids did not improve from period 1 ( $n = 45$ ; 36.3%) to period 2 ( $n = 55$ ; 30.1%), with difference at 6.2% (95% CI  $-4.5$  to 16.9%). Median of fasting time

from liquids was 5:00 hours (IQR 2:10–11:30 hours) in period 1 and 5:23 hours (IQR 2:29–11:21 hours) in period 2. This difference was not statistically different based on the Mann-Whitney test ( $P = .74$ ).



**Fig 2.** Duration of fasting from clear liquids: A = <3 h; B = 3–6 h; C = 6–12 h; D = >12 h. Duration of fasting from solid foods: A = <8 h; B = 8–12 h; C = 12–18 h; D = >18 h. A indicates adequate duration of fasting; B, C, and D indicate inadequate duration of fasting. (Color version of figure is available online.)

#### Guideline awareness

Data were available from 153 (83%) patients about their awareness of the fasting guidelines. Many of them ( $n = 131$ ; 86%) stated they had been informed about the fasting guidelines by nurses, surgeons, anesthesiologists, or all of them. Only 44 (29%) patients were aware of the 6 hours of fasting from solids, and 51 (33%) patients were aware of the 2 hours of fasting from clear liquids. About half of the patients thought that they had to fast from solids ( $n = 82$ ; 54%) and liquids ( $n = 70$ ; 40%) from midnight onward.

#### Duration to restore oral intake and perioperative fasting

Time to restore oral intake was observed among 184 patients during period 2 (Fig 1). Some patients were excluded, because 31 (16.8%) patients provided unclear answers regarding exact time, 20 (10.9%) patients were on a prescribed liquid diet after surgery, of whom 17 had undergone oncological or gastroenterological surgery, and 9 (4.9%) patients had a nil-per-mouth policy during their postoperative course.

#### Food intake

Time to restore food intake was adequate in 46 patients (30.7%). It took at least 8 hours to resume intake of solid foods in 51 patients (33.3%) (Fig 3). The median time to resume food intake was 5:35 hours (IQR 03:32–14:53 hours) (Table III). Median time to restore food intake was 3 times longer in patients undergoing oncologic or gastroenterological surgery compared to other surgical specialties (Supplementary File S2). The median duration of perioperative fasting from solid foods was 23:46 hours (IQR 20:00–30:30 hours) (Table III). Almost half of the patients ( $n = 67$ ; 43.8%) abstained from food for more than 24 hours. Perioperative fasting was less than 18 hours in 21 patients (13.7%) (Fig 4).

#### Fluid intake

Time to restore fluid intake was adequate in 60 patients (41.7%) (Fig 3). One hundred and twenty-four patients (86.1%) had a drink within 6 hours after surgery. Median time to restore fluid intake was 2:56 hours (IQR 1:38–4:13 hours) (Table III). For perioperative

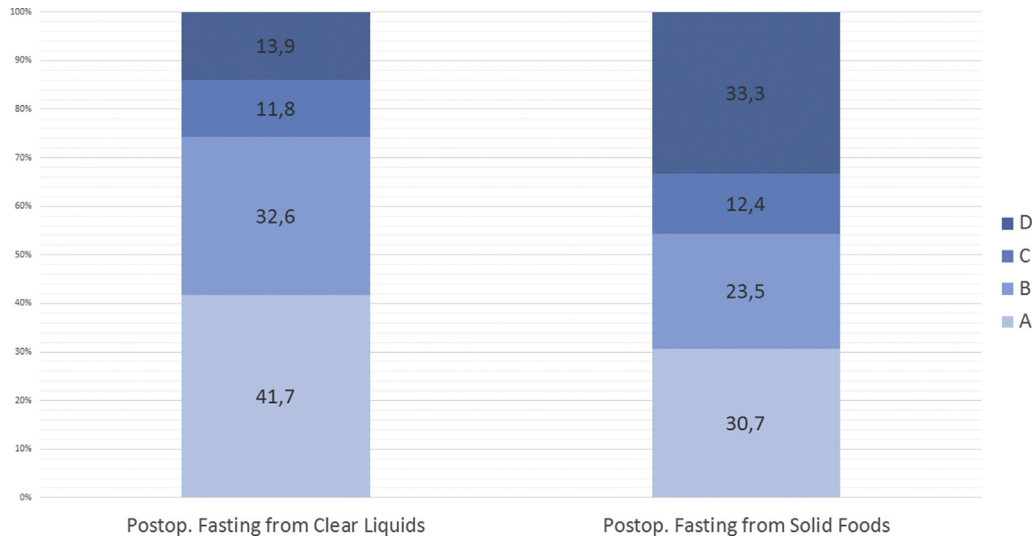
fasting from clear liquids, the median duration was 11:00 hours (IQR 7:53–16:00 hours). A small majority ( $n = 76$ ; 53.6%) abstained from clear liquids for less than 12 hours (Fig 4).

#### Discussion

Despite the 20-year existence of registered preoperative fasting guidelines, our results demonstrate prolonged preoperative fasting times in an academic and a general Dutch hospital. Current adherence to preoperative fasting recommendations for solid foods appeared to be even suboptimal compared to the period 10 years ago. Duration of preoperative fasting was 2.5 times longer than the recommended 6 hours for solid foods and 3 times longer the recommended 2 hours for clear liquids. Fasting behavior was severely inadequate (ie, more than 18 hours from solid foods or 12 hours from clear liquids) in each fourth or fifth patient, respectively. Notably, half of the patients stopped eating and drinking before midnight. Median duration of the time of preoperative fasting and the time to resume intake after surgery was almost 24 hours.

Prolonged fasting can be caused by several factors. First, the opportunity to have breakfast is hindered by early morning scheduled surgery because that is within 6 hours before surgery. However, drinking is allowed up to 2 hours before surgery, yet such is still not common practice. Secondly, surgeries scheduled in the afternoon did, unexpectedly, not lead to shortened duration of fasting as our findings illustrate. Low awareness among preoperative patients regarding correct fasting guidelines despite being informed beforehand is another factor since half of the patients in our study thought they had to stop eating and drinking before midnight.<sup>21</sup> Although our study did not evaluate the way instructions were provided, an increased awareness of correct preoperative fasting is needed for both patients and health care providers. Another factor may be operation schedules with delayed or undetermined starting times.<sup>13,22,23</sup> The most important factor from our study appears to be that patients are still instructed to fast from midnight. The European Society of Anaesthesiology guidelines explicitly suggest that patients should be encouraged to keep drinking until 2 hours before surgery.<sup>6</sup> This study clearly





**Fig 3.** Duration of postoperative fasting for clear liquids: A = <2 h; B = 2–4 h; C = 4–6 h; D = >6 h. Duration of postoperative fasting for solid foods: A = <4 h; B = 4–6 h; C = 6–8 h; D = >8 h. (Color version of figure is available online.)

**Table III**  
Duration of postoperative and perioperative fasting during period 2

	Duration of postoperative fasting*				Duration of perioperative fasting*			
	n	25th	Median	75th	n	25th	Median	75th
Fasting from clear fluids	144	01:38	02:56	04:13	135	07:53	11:00	16:00
Urgency of surgery								
Elective	111	01:36	03:03	04:27	104	08:16	11:48	15:30
Emergency	33	02:02	02:30	03:58	31	07:00	10:00	16:30
Time of surgery								
Morning	80	01:51	03:13	03:57	73	07:30	12:15	17:38
Afternoon	57	01:15	02:29	03:58	56	07:52	10:30	14:00
Evening-night	6	02:45	03:35	06:55	5	09:49	11:00	15:25
Fasting from solid foods	153	03:32	05:35	14:53	146	20:00	23:46	30:30
Urgency of surgery								
Elective	117	03:42	05:46	15:35	113	17:11	23:30	34:00
Emergency	36	03:17	04:53	12:23	33	14:36	24:00	29:15
Time of surgery								
Morning	83	04:06	06:15	17:14	78	20:09	23:30	31:00
Afternoon	62	03:20	08:39	11:58	61	20:27	24:00	30:30
Evening-night	7	03:02	09:35	12:49	6	17:17	21:03	27:38

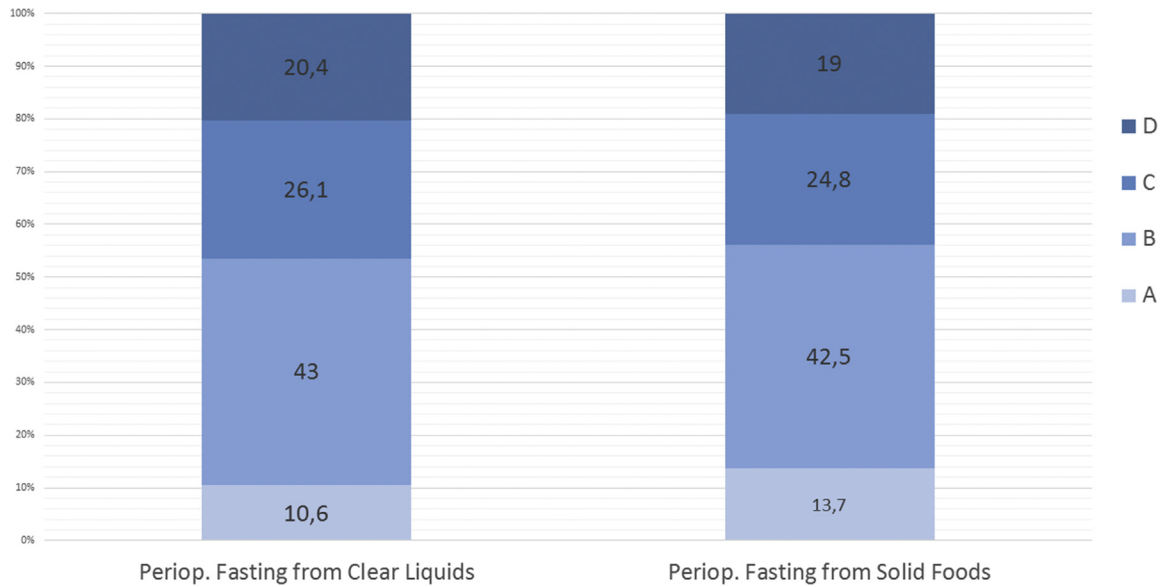
\* 25th, median, and 75th percentiles are presented in hours and minutes.

demonstrated that this recommendation is not well implemented in clinical practice. This gap between the official guidelines and clinical practice seems difficult to overcome, which has been demonstrated before.<sup>24,25</sup> The aforementioned factors affirm that patients stop eating and drinking too soon, and this can be addressed through further research and implementation of the guideline.

Prolonged fasting can have physical and emotional consequences.<sup>26</sup> Physical consequences include increased thirst and hunger and metabolic impairment.<sup>26–28</sup> The metabolic effect of prolonged fasting is decreased insulin sensitivity,<sup>29</sup> which is associated with increased risk of major postoperative complications, such as mortality and infection.<sup>30</sup> Furthermore, prolonged fasting may be associated with cardiac stress and hypothermia.<sup>31</sup> Emotional consequences include patients' feeling loss of control, as they are not allowed to have food or drinks. Patients are aware that they have to fast, but they sometimes do not understand what fasting or nil-per-mouth means and why it is recommended.<sup>26</sup> Health care professionals may consider fasting as an easy task; however, when patients have to be encouraged to consume nutritional products until a certain time point, as the guidelines

explicitly recommend, fasting may be more complex.<sup>32</sup> Therefore, it may be wise to shift health care professionals' discourse from instructing patients what not to do (ie, eating and drinking) to educating them about prevention strategies they can use to avoid unnecessarily long fasting times (eg, they should eat and drink as long as allowed) to reduce the risk of postoperative complications. To reduce the time of postoperative fasting, postoperative intake should be stimulated as soon as possible. Several interventions may help, such as providing room service or improving meal conditions.<sup>33,34</sup>

Our findings have clinical implications for surgeons, anesthesiologists, nurses, and dieticians. There is a growing body of evidence suggesting that preoperative consumption of carbohydrate beverages is safe,<sup>35</sup> reduces postoperative insulin resistance,<sup>35–37</sup> positively influences well-being (eg, malaise, thirst, hunger, and weakness,<sup>38</sup> nausea and vomiting,<sup>39</sup>) and shortens duration of hospital stay up to 1 day.<sup>36,40,41</sup> Moreover, preoperative consumption of carbohydrate beverages has been used in several fields of surgery. Therefore, patients' instructions should not only emphasize when they should stop eating and drinking but also should encourage them to keep eating and drinking until 6 hours and 2



**Fig 4.** Duration of perioperative fasting for clear liquids: A = <6 h; B = 6–12 h; C = 12–18 h; D = >18 h. Duration of perioperative fasting for solid foods: A = <18 h; B = 18–24 h; C = 24–36 h; D = >36 h. (Color version of figure is available online.)

hours, respectively, before surgery.<sup>6</sup> This approach has been studied and has shown decreased fasting duration and decreased sensation of thirst.<sup>42,43</sup>

To prevent another decade passing without any improvement in guideline adherence, health care professionals, researchers, and staff members should change the fasting paradigm into planned eating and drinking before and after surgical procedures. Nurses and other health care workers should adjust their behavior and encourage patients to eat and drink as long as possible, within the limits of the applicable guidelines.<sup>6</sup> Although evidence shows that preoperative consumption of oral carbohydrate beverages is safe<sup>35</sup> and ERAS protocols include eating recommendations,<sup>44</sup> suggestions for translating this knowledge to daily practice are lacking.<sup>24</sup> Knowledge translation may be difficult in this case because patients are primarily instructed to eat sufficiently within prehabilitation programs.<sup>2–5</sup> This is complemented by fasting instructions during the direct preoperative period. Implementing concrete instructions about what and when to eat and then to not eat and drink may be complex for both patients and health care professionals. After surgery, patients must continue eating while sleepy from narcosis, in pain, or feeling nauseous. Behavioral change techniques or knowledge translation models are needed to achieve optimal fasting regimens in surgical patients.<sup>24,45,46</sup> Future studies on perioperative eating and drinking should focus on awareness and translation of knowledge into daily practice. Furthermore, these future studies can incorporate lessons learned from other studies about how to deimplement old habits.<sup>47,48</sup>

This study has some limitations. Estimation of the duration of fasting may have been imprecise. First, time intervals of eating and drinking were estimated by the patients themselves, and these estimations may be imprecise. Notably, routine preoperative assessments of the duration of fasting before surgery are usually based on the patients' responses as well; therefore, we argue that our findings are still valid. Moreover, the duration of the surgical procedure (eg, start and end time) recorded in the patients' records may not be accurate. These errors may occur on both sides of the true interval, so we believe our conclusions are still valid.

A second limitation concerns the consumption of ice pops during the patients' stay at the post anesthesia care unit (PACU).<sup>49</sup>

During the direct postoperative period in the PACU, ice pops may have been provided to some patients during both study periods. Unfortunately, these consumptions were not recorded because the patients did not remember it, as it happened shortly after narcosis. As such, the actual time of abstinence from fluids may be shorter than our results suggest for patients who consumed ice pops at the PACU. However, these ice pops contain a limited amount of fluid that hardly contributes to postoperative metabolic recovery and therefore have not been taken into account.

A third concern includes the fact that we used data from 2 Dutch hospitals from 2 study periods. Procedures of data collection within these periods may lack consistency; for instance, patients were asked about the time of the last meal during the first day after surgery (period 1, sites A, and period 2, both sites) or preoperatively at the holding period (period 1, site B). Hospital routines may have also changed. Moreover, patients included in period 2 were older, and the duration of the surgery they underwent was longer compared to period 1. Nevertheless, this should not influence preoperative fasting times. Undergoing major surgery can increase postsurgical symptoms, which may hinder nutritional intake (eg, lack of appetite, nausea, full stomach, food tastes differently, difficulty chewing or swallowing). However, we were not able to determine whether this explains the postoperative fasting times or not because we did not observe postoperative fasting in period 1.

Finally, our findings are funded on data from samples of an academic and general hospital taken during the years 2009 and 2019. We have several arguments to support our findings as representative and relevant. First of all, prolonged preoperative fasting was a consistent finding over both the years with a decade in between. Secondly, a search through the websites of 25 larger (ie, at least 600 beds) Dutch hospitals showed that hospitals commonly advise to fast from solid food and fluids for 6 and 2 hours, respectively, before admission time, including on the website of 1 of the hospitals that participated in our study. Thirdly, prolonged fasting was found in other countries with comparable sample sizes such as Iceland,<sup>21</sup> Turkey,<sup>31,50</sup> Brazil,<sup>51,52</sup> South Africa,<sup>14</sup> and Oman,<sup>53</sup> including low awareness of hospital staff in Germany<sup>13</sup> and Egypt.<sup>54</sup> Therefore, despite representing only 2 settings, we are convinced that our findings are relevant and indicate throughout revision of current fasting guidelines and practices.

In conclusion, patients stop eating and drinking too soon before surgery in 2 Dutch hospitals, despite the introduction of the preoperative nutritional guidelines 20 years ago. Duration of fasting from solid foods and clear liquids is, respectively, 2.5 and 3 times longer than the recommended 6 and 2 hours. Recommendations to keep eating until 6 hours and drinking until 2 hours before surgery are not applied in daily practice. Taking the total perioperative course into account, almost half of the patients abstain at least 24 hours from solid foods and at least 12 hours from clear liquids. For this reason, it is urgent that all health care professionals ensure that their patients understand that they can eat up to 6 hours and drink up to 2 hours before surgery and restart nutrition postoperatively according to the ERAS protocol.

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### Conflict of interest/Disclosure

The authors have no conflict of interests to declare.

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### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [<https://doi.org/10.1016/j.surg.2021.01.037>].

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