



## Decreased food intake is a risk factor for mortality in hospitalised patients: The NutritionDay survey 2006<sup>☆</sup>

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### SUMMARY

**Background & aims:** Malnutrition is a known risk factor for the development of complications in hospitalised patients. We determined whether eating only fractions of the meals served is an independent risk factor for mortality.

**Methods:** The NutritionDay is a multinational one-day cross-sectional survey of nutritional factors and food intake in 16,290 adult hospitalised patients on January 19th 2006. The effect of food intake and nutritional factors on death in hospital within 30 days was assessed in a competing risk analysis.

**Results:** More than half of the patients did not eat their full meal provided by the hospital. Decreased food intake on NutritionDay or during the previous week was associated with an increased risk of dying, even after adjustment for various patient and disease related factors. Adjusted hazard ratio for dying when eating about a quarter of the meal on NutritionDay was 2.10 (1.53–2.89); when eating nothing 3.02 (2.11–4.32). More than half of the patients who ate less than a quarter of their meal did not receive artificial nutrition support. Only 25% patients eating nothing at lunch receive artificial nutrition support.

**Conclusion:** Many hospitalised patients in European hospitals eat less food than provided as regular meal. This decreased food intake represents an independent risk factor for hospital mortality.

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### 1. Introduction

Already in 1977 Hill et al. showed that many surgical patients<sup>1</sup> have signs of malnutrition. Poor nutritional status has been

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<sup>o</sup> See [www.nutritionday.org](http://www.nutritionday.org).

identified as an indicator for an increased likelihood of complications.<sup>2–5</sup> Inadequate food intake has been shown to increase mortality in a small group of selected patients,<sup>5</sup> but food intake was not stratified and neither nutritional status nor recent changes in nutrition behaviour were considered. A poor nutrient intake was associated with a higher rate of infections, poor wound healing, more frequent cardiac complications and hence prolonged hospital stay.<sup>2,6–13</sup> The proportion of hospitalised patients with an altered nutritional status based on criteria such as body mass index (BMI), recent weight loss or a history of undernutrition was between 7 and

50%<sup>4</sup> and largest in South America.<sup>12,13</sup> Simple interventions to increase food intake such as protected meal times, more menu choices, additional snacks, motivation of patients or sip feedings have been proposed to prevent or reverse a further loss in body weight.<sup>14,15</sup> However, the effect of the fraction of the meal eaten on mortality has not been determined on a large scale.

Insufficient nutritional intake in hospital was addressed in 2003 by a resolution from the European Council<sup>16</sup>; and in 2006 by guidelines by UK's National Institute for Health and Clinical Excellence (NICE)<sup>17</sup>; however, it is unknown whether these initiatives have had any impact on nutrition care in European hospitals.

We designed the NutritionDay Study 2006 to determine the effect of food intake on all cause 30-day mortality in a large number of hospitalised patients in addition to nutritional and clinical risk factors.

## 2. Methods

### 2.1. Study design, questionnaires and recruitment

The NutritionDay Study consisted of a one-day cross-sectional audit of patient food intake followed by an outcome evaluation 30 days later. The audit was done using three questionnaires (Supplementary material eFig. 1, eFig. 2, eFig. 3a and 3b: the actual 2009 version of the NutritionDay questionnaires), available in 27 languages (free download from [www.nutritionday.org](http://www.nutritionday.org)). The first questionnaire addressed the structure of the ward in which the patient resided to be completed with the help of the head nurse or physician and the second considered the caregiver's view of the patient, including data on patient's age, height, weight, medical condition, comorbidities, type of nutritional intake. The third questionnaire allowed patients to self-report their actual food intake, including how much they ate for each meal during the NutritionDay, why they did not eat their full meal and their nutrition history before hospitalisation. Food intake at each meal was recorded by patients on questionnaire 3b (Supplementary material eFig. 3b) using simple categories (all, about a half, about a quarter, nothing) similar to those used by Olin et al.<sup>15</sup> A symbolic plate was used to visualize a meal in addition to the written categories and the instruction stated on the sheet: "Please tick a circle for each meal to indicate how much you ate today". Nutritional history was recorded on questionnaire 3a with the use of selected categories that were already proposed in questionnaires to screen patients for nutrition risk and malnutrition from three scientific societies, the British Association for Parenteral and Enteral Nutrition (BAPEN),<sup>18</sup> the European Society for Clinical Nutrition and Metabolism (ESPEN)<sup>19</sup> and the Austrian Society for Clinical Nutrition (AKE).<sup>20</sup> If needed, patients received help to fill out the third questionnaire by students, student nurses, relatives, etc. Pilot data acquisition showed that personnel specialised in nutrition was not needed to fill out the questionnaires.

Participation was open to any ward that registered at the website with an individual email and requesting an anonymous centre and ward code. Enrollment was mainly promoted through national clinical nutrition societies represented in the council of the European Society of Clinical Nutrition and Metabolism (ESPEN). The coordinating centre in Vienna gained ethical approval for multi-centre data collection, local approval was additionally necessary in some hospitals according to the different national standards and local interpretations for observational research and audits. All hospitals were instructed to inform patients with the standardised patient information sheet about their right to refuse participation (see Patient information sheet in the Supplementary material). The responsibility to obtain local approval was within the individual hospitals. The NutritionDay

2006 took place on Thursday January 19th 2006, although for local reasons a few wards collected data on a different Thursday. Outcome data were recorded by the local responsible coordinator 30 days after NutritionDay. Data entry was inputted on a dedicated multilingual website ([www.nutritionday.org](http://www.nutritionday.org)).

### 2.2. Statistics and analysis

The effect of risk indicators on mortality was quantified with crude odds ratios for dying in hospital within 30 days. Participants had several possible outcomes (to get discharged home, to die, to be transferred to other institution or to be still in hospital) and these competing events removed the subject from being at risk to die in the hospital. The probability of dying in hospital was calculated by applying competing risk methodology using the risk set of patients still remaining in hospital<sup>21</sup> on a given day after hospital admission.

For univariate association between a risk factor and the risk for dying in hospital within 30 days, unadjusted cumulative probabilities for dying in hospital were calculated based on the original cross-sectional prevalence data. In a cross-sectional survey, patients with longer length of stay are more likely to be included in the surveyed population. Adjusted cumulative probabilities for dying in hospital were based on estimated incidence data, by accounting for the length bias of cross-sectional sampling and censoring at day 30, resulting in different weighting of each individual case.<sup>22</sup> For between group comparisons permutation tests were performed based on 1500 random permutations using the difference in 30-day mortality as a test statistic. Per risk factor Bonferroni correction was used for multiple comparisons with a reference group.

For multivariate survival analysis the proportional sub-distribution hazards' regression model of Fine and Gray<sup>23</sup> was used including time since ward admission as a covariable. We included all variables which reached significance in the univariate analyses and in a joint non-stepwise multivariate analysis. We entered two patient factors related to demographic factors (age, gender), five disease related factors (disease affected organ systems, comorbidities, previous ICU stay, number of days that the patients had already spent in hospital before NutritionDay, number of drugs taken daily), three factors related to the ward (its specialty, the number of beds in the ward, the presence of dedicated individual or team-based nutritional care provision), two factors concerning patient's autonomy (ability to walk, help needed to fill patient questionnaire), and five indicators related to nutritional status (BMI in seven categories, weight loss in the previous 3 months, amount eaten during the last week, fraction of meal eaten on NutritionDay, number of snacks eaten on NutritionDay), as well as the interaction between eating behaviour (amount eaten during the last week, how much they ate on NutritionDay) and age, and the interaction between eating behaviour and number of days the patient had already spent in hospital previous to NutritionDay. We present results only for the fraction for food intake at lunch. Fraction of the meal eaten at lunch was highly positively correlated with intake at other meals with a Kendall's correlation coefficient of 0.6 and larger.

For all the above calculations, sensitivity analyses were performed with a restricted data set including only wards with more than five beds, with at least 50% of patients participating on NutritionDay and at least 90% of outcomes recorded.

All analyses were done with the help of a statistical program (SAS 9.1, R 2.6.0). *p*-values less than 0.05 were considered statistically significant. 95% confidence intervals (CI) are given for odds ratios (OR) and hazard rates (HR). Data are presented throughout as proportions or medians with the interquartile range (IQR) between participating wards. Proportion or median was calculated from the

whole sample. For each ward, the proportion or median of its participants was computed and the interquartile range based on this distribution of proportions or medians in the sample of all individual wards is given.

### 3. Results

#### 3.1. Demographics

A total of 16,455 patients treated in 748 wards from 256 hospitals in 25 countries participated. Wards from 16 different specialties participated. Ward size ranged from 18 to 31 beds. Median patient recruitment within each ward was 93% (IQR 75–100%) of occupied beds. From the 16,455 participating patients, 16,290 (99%) were aged 18 or older and these individuals (Table 1) are included in all analyses. The patients' characteristics are described in Table 2. Nutrition history was obtained from 14,665 (90%) participants, and individual information about actual food intake on NutritionDay was obtained from 14,474 (89%) patients. The criteria for the sensitivity analysis were fulfilled for 11,407 (70%) patients.

#### 3.2. Nutritional intake on NutritionDay

Individual food intakes on NutritionDay were similar for all three main meals: less than half of all patients finished their meals (Table 3). Of the patients eating less than the full regular meal or nothing at lunch, 73% (IQR 57–100%) gave at least one reason for this. The most frequent reason for eating less or nothing was “not being hungry” which was selected by 43% of the patients giving a reason. The other most frequently stated reasons for not completing the served meal were “normally eating less”, “don't like the taste”, “don't want to eat” and “having nausea”.

Regular hospital food with no particular dietary plan was the source of nutrition for 59% (IQR 37–82%) of the patients; 15% (IQR 0–24%) of patients were given hospital food but modified for some form of special diet, 2% (IQR 0–0) were taking only supplements, and 9% (IQR 0–11%) were on enteral or parenteral nutrition (Table 3).

#### 3.3. Nutritional support

The majority of the patients that reported that they did not eat anything for various reasons had been served exclusively hospital food according to the caregivers (Table 3). The proportion of patients receiving artificial nutrition increased clearly to above 20% only for patients indicating that they were eating nothing, whereas only 5–8% of patients eating half or a quarter received artificial nutrition.

#### 3.4. Food intake and outcome

Outcome and date of the outcome were recorded at hospital discharge or Day 30 after NutritionDay in 14,447 patients. A total of

**Table 1**  
Patients demographics of all recruited patients aged 18 or older.

		Median	Quartiles based on units medians	N
Age	Years	66	58–73	16,290
Actual weight	kg	70	66–75	15,123
Typical weight	kg	74	70–78	11,538
BMI	kg/m <sup>2</sup>	24.9	23.7–26.1	14,809
		Proportion (%)	Quartiles of proportion (%) per unit	
Gender	% Female	47.2	33.8–60.0	14,665

**Table 2**  
Patients characteristics of all recruited patients aged 18 or older.

		Proportion (%)	Quartiles of proportion (%) per unit	N	
Previous surgery		24.7	0–48.1	16,290	
ICU stay		10.2	0–15.4	16,290	
Help with questionnaires		51.4	25–77.8	14,665	
Comorbidities	No comorbidity	45.1	18.2–68.4	16,290	
(multiple answers possible)	Cardiac insufficiency	9.4	0.0–15.0	16,290	
	Diabetes	15.0	5.0–20.8	16,290	
	Stroke	4.4	0.0–5.6	16,290	
	COPD	5.7	0.0–9.1	16,290	
	Myocardial infarction	3.9	0.0–5.6	16,290	
	Others	30.2	5.6–50.0	16,290	
	Affected organs	Brain, nerves	13.5	0.0–15.8	16,290
	(multiple answers possible)	Eye, ear	2.7	0.0–0.0	16,290
		Nose, throat	4.0	0.0–0.0	16,290
		Heart, circulation	21.4	0.0–33.3	16,290
Lung		13.0	0.0–17.9	16,290	
Liver		6.9	0.0–9.1	16,290	
Gastrointestinal tract		19.2	0.0–27.3	16,290	
Kidney/urinary tract		8.2	0.0–9.1	16,290	
Endocrine system		5.9	0.0–7.1	16,290	
Skeleton/bone/muscle		14.4	0.0–16.0	16,290	
Blood/bone marrow		4.3	0.0–3.8	16,290	
Skin		2.9	0.0–3.0	16,290	
Ischaemia		1.5	0.0–0.0	16,290	
Cancer		13.7	0.0–5.4	16,290	
Infection	5.5	0.0–6.7	16,290		
Others	7.2	0.0–7.7	16,290		

634 patients (3.9%) died. Mortality was only slightly higher (4.4%) when the outcome analysis was restricted to those wards that met the criteria for sensitivity analysis. The odds ratio for dying within 30 days while in hospital increased progressively as the amount consumed during NutritionDay decreased (Fig. 1). After adjustment for length bias the cumulative incidence of death increased from less than 1% for those eating their full meals to nearly 9% for those eating nothing on NutritionDay, despite being allowed to eat (permutation test  $p$ -value < 0.001) (Fig. 2). Consuming half of the food provided on NutritionDay was only associated with a trend for increased mortality (permutation test  $p$ -value 0.033) but eating a quarter increased significantly the risk for dying (permutation test  $p$ -value < 0.001). Those patients who were not allowed to eat anything, or who missed the meal because they were attending an examination, did not affect the cumulative incidence curve (permutation test  $p$ -value 0.960) for death within 30 days.

#### 3.5. Risk indicators of malnutrition

A low BMI <18.5 was found in 6%, a normal BMI (18.5–25) in 40%, a moderately elevated BMI (25–30) in 30%, a severely elevated BMI (30–40) in 15%, an extremely elevated BMI > 40 in 2% and in 9% the BMI could not be calculated due to missing data. Compared with participants with a normal BMI, the odds ratio for dying was increased to 2.0 (95% CI 1.6–2.6) for participants with a very low BMI and reduced to 0.5 (95% CI 0.4–0.6) in moderately or severely obese patient with a BMI between 25 and 40.

Weight loss in the previous 3 months was reported in 42% (IQR 28–56%) of participants and was larger than 6 kg in nearly half of these patients. Eating less than usual during the previous week was self-reported by 51% (IQR 35–61%) of patients. Both weight loss in the previous 3 months and eating less than usual during the previous week were associated with an increased risk of death (Fig. 3).

The cumulative incidence of death adjusted for length bias increased from less than 1% for those eating normally during the

**Table 3**  
Nutritional care in patients according to their food intake at lunch,  $n = 16,290$ .

Amounts of food eaten at lunch	n	Type of nutrition provided to the patients (row percentages)						
		Hospital food (%)	Special diet (%)	Protein supplement (%)	Artificial nutrition (%)	Combined (%)	Other (%)	No nutrition care information (%)
All	16,290	59	15	2	9	4	4	7
Complete meal	5509	69	15	1	5	4	2	4
Half meal	3673	64	17	3	6	5	2	4
Quarter meal	1596	59	18	3	8	6	3	3
Nothing (eating allowed)	748	43	14	4	21	7	8	3
Nothing (eating not allowed)	1124	42	11	1	25	3	13	6
Missing	3610	46	12	3	13	4	5	17

previous week to more than 6% for those eating less than 25% of their usual amount during the previous week (permutation test  $p$ -value < 0.001). To exclude an effect of age we analysed the time course of the cumulative incidence of death separately for each of four age quartiles. The association of an increased cumulative incidence curve for death with decreased food intake was present in all four age groups. The impact of previous or actual food intake on mortality was dramatically increased with increasing age (Supplementary material Figs. 4 and 5).

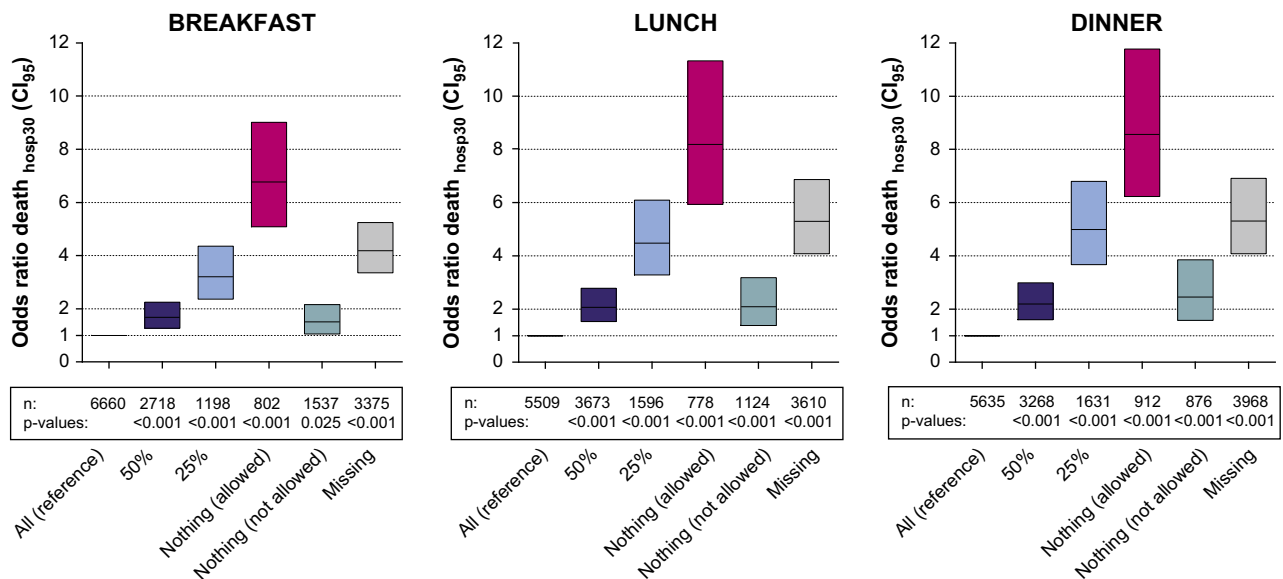
3.6. Multivariate analysis of risk factors for 30-day mortality

BMI, the fraction eaten on NutritionDay, total number of snacks eaten on NutritionDay and the amount eaten during the previous week were all significant predictors for dying in hospital up to 30 days after NutritionDay. In addition to the four out of five nutritional factors, one out of two demographic factors, three out of five disease related factors, one factor related to the medical specialty of the ward, and both factors related to the patient's autonomy, remained in the final model (Tables 4A and 4B). In the multivariate analyses, essentially the same results were obtained when food intake at lunch was replaced by food intake at breakfast or dinner. Inclusion of hospitals or countries as independent factor did not have a noticeable effect on the model estimates. Hospitals had a significant effect whereas countries did not contribute significantly to the model. The multivariate analyses restricted to data fulfilling the sensitivity criteria showed similar results.

4. Discussion

The NutritionDay Study 2006 was designed to determine the effect of decreased food intake and other common nutritional risk factors on the outcomes of hospitalised patients. We found that 60% of the patients present on NutritionDay in the participating hospitals did not eat their full regular meal. We found that, in this single-day audit of food intake, even when taking into account other variables, a progressive increase of 30-day mortality was associated with decreased food intake.

Clearly, nutritional intake is reduced and subsequently absent in end stage disease. We are fully aware that, in respect of the association between food intake and risk for death, food intake is likely to be a surrogate for severity of disease. However, the clearness and reproducibility of the relationship between decreased food intake and risk for dying in hospital were surprising. In univariate analysis, after adjustment for the higher probability to be in the NutritionDay survey for patients with a longer length of stay (Fig. 2) or adjustment for age (see additional Supplementary material eFig. 4) and in the multivariate model accounting for severity of disease, the increasing risk for dying in hospital with decreasing reported food intake on NutritionDay and during the previous week was a consistent finding. We did not attempt to determine what amount of food intake would be appropriate in relation to BMI, to the course of disease or timing after surgery because considerable variation in practice has been found between individual hospitals. Moreover, no universal practice agreement exists about what is the appropriate



**Fig. 1.** Relation between fractions of food intake at breakfast, lunch and dinner and death in the hospital up to 30 days of follow-up after NutritionDay. Patients that did not eat anything were divided into those allowed to eat and those who were not allowed to eat or had an examination,  $n = 16,290$ .

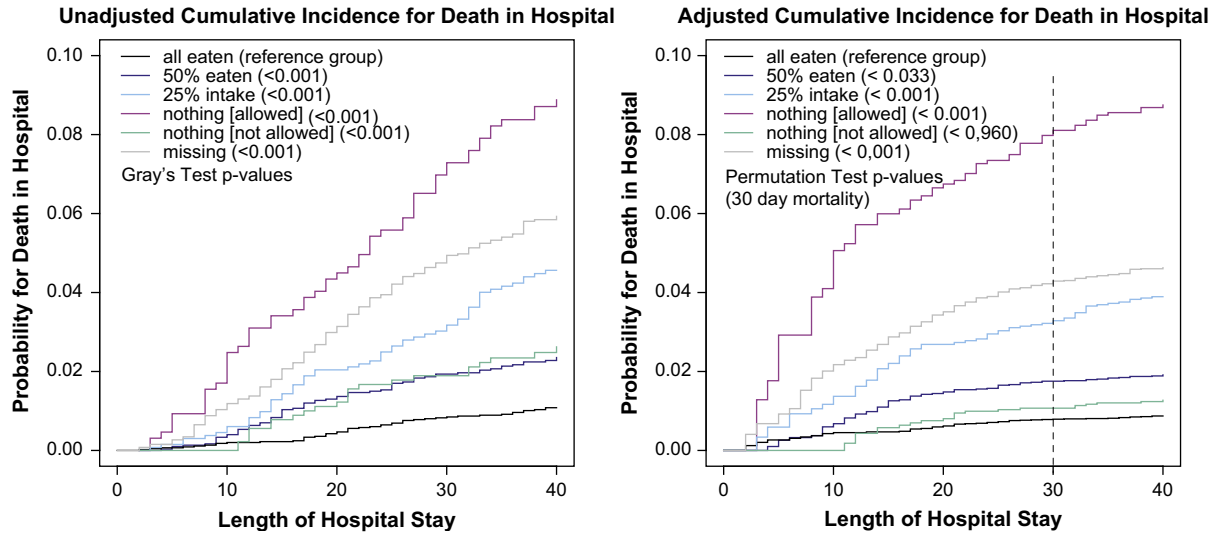


Fig. 2. Unadjusted and adjusted cumulative incidence of death depending on food intake at lunch versus length of stay in hospital. Adjustment is for length bias of the cross-sectional data collection and censoring at day 30 after inclusion,  $n = 12,727$ .

amount to be eaten on a given day before or after an intervention or surgery. The possible benefit of changing traditional nutrition care after abdominal surgery is illustrated by the “enhanced recovery after surgery” program where length of stay decreased by more than 25% without side effects.<sup>24</sup> We used food intake at one meal as an indicator for total food intake because the effect on outcome was similar for all three meals and the food intake at the three meals was significantly positively correlated. We think that total food intake can only be determined with the help of specialised personnel in dietetics and the hospital kitchen or food provider. Thus we did not try to calculate total food intake because the weight to be given to individual meals would be quite arbitrary.

Noteworthy, there is no universal measure for severity of illness in normal hospital ward patients. We therefore used ability to walk, help

needed to complete the patient questionnaire, disease affected organs, previous ICU stay, number of days spent in hospital before the NutritionDay, the numbers of drugs taken daily, and the presence of comorbidities as proxies for severity in the multivariate analysis.

We found that the effect of decreased food intake on mortality remains significant even after adjustment for an altered nutritional status and a history of undernutrition. Only one study reported a similar effect of actual decreased food intake on mortality<sup>5</sup> but they did not stratify this effect according to the level of decreased intake and did not evaluate the impact of an altered nutritional status or history of recent undernutrition. Many other large studies found the prevalence of an altered nutritional status and history of undernutrition<sup>2,6–13</sup> to be between 7 and 50%. Only a few studies have also investigated the effect on mortality.<sup>3,4,25</sup> We did not

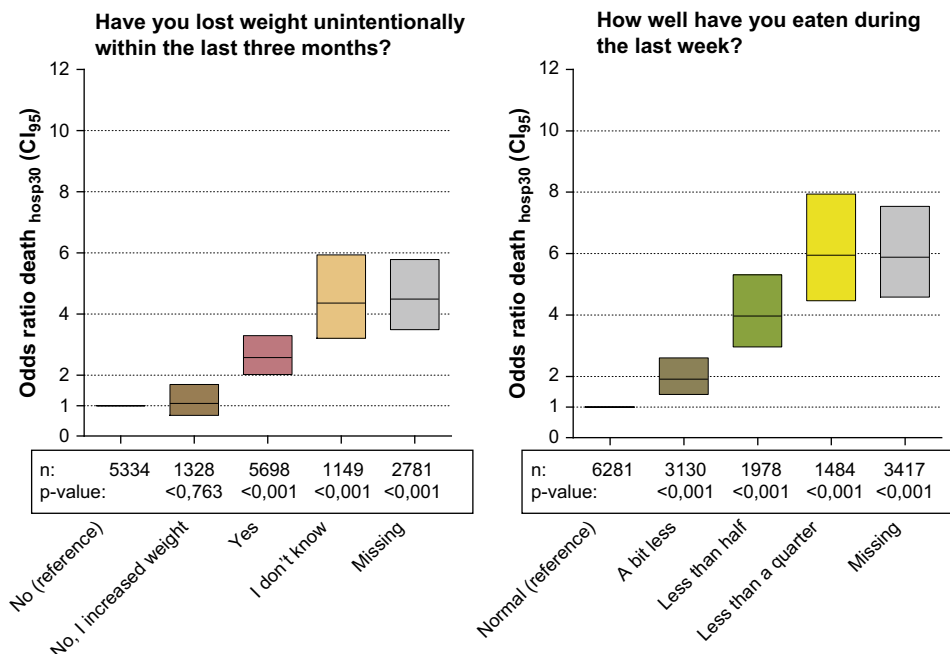


Fig. 3. Relation between weight loss within the last 3 month or decreased food intake last week and odds ratio for death in the hospital up to 30 days of follow-up,  $n = 16,290$ .

**Table 4A**Multivariate analysis of the association between risk indicators and mortality ( $n = 12,727$ ).

Variable	HR (95% CI)	p-Value
<b>Demographic</b>		
Age <sup>a</sup>	1.28 (1.21–1.37)	<0.0001
Gender		n.s.
<b>Disease related</b>		
Affected organ (ICD-10 groups) <sup>b</sup>		
Cancer ( $n = 1940$ )	1.84 (1.46–2.31)	<0.0001
Lung ( $n = 1818$ )	1.31 (1.06–1.61)	0.012
Liver ( $n = 912$ )	1.77 (1.37–2.29)	<0.0001
Endocrine system ( $n = 744$ )	0.57 (0.35–0.93)	0.025
Skeleton/bone/muscle ( $n = 1850$ )	0.60 (0.44–0.82)	0.014
<b>Comorbidity</b>		
No comorbidity marked ( $n = 5313$ )	1.0	Reference
Cardiac insufficiency ( $n = 1266$ )	1.37 (1.09–1.73)	0.007
Diabetes, stroke, COPD		n.s.
Myocardial infarction, others		n.s.
Any ICU stay before NutritionDay		n.s.
Days already in hospital on NutritionDay <sup>c</sup>	1.02 (1.01–1.04)	0.006
How many drugs do you take each day?		n.s.
<b>Structural factor</b>		
Specialty <sup>d</sup>		
General internal medicine ( $n = 2631$ )	1.0	Reference
Neurology ( $n = 584$ )	0.38 (0.20–0.72)	0.003
Surgery ( $n = 2096$ )	0.54 (0.38–0.76)	0.0004
Unit size (maximum beds)		n.s.
Nutrition care services		n.s.
<b>Autonomy</b>		
Can you walk without assistance?		
Yes ( $n = 7237$ )	1.0	Reference
No, only with assistance ( $n = 2161$ )	2.04 (1.52–2.74)	<0.0001
No, I stay in bed ( $n = 1302$ )	3.39 (2.52–4.57)	<0.0001
Missing ( $n = 2027$ )	2.65 (1.77–3.95)	<0.0001
Did anyone help you to complete this questionnaire?		
No ( $n = 5896$ )	1.0	Reference
Yes ( $n = 5887$ )	1.45 (1.11–1.89)	0.007
Missing ( $n = 944$ )	0.63 (0.47–0.86)	0.003

<sup>a</sup> HR for 10 years.<sup>b</sup> Affected organs analysed: brain/nerves, eye/ear, nose/throat, heart/circulation, lung, liver, gastrointestinal tract, kidney/urinary tract, endocrine system, keleton/bone/muscle, blood/bone marrow, skin, ischaemia, cancer, infection, others. Hazard ratios indicate deviation from mean of all organs affected.<sup>c</sup> HR per week.<sup>d</sup> Specialties analysed: general internal medicine, gastroenterology, oncology, cardiology, infectious diseases, geriatrics, neurology, ear–nose–throat, general surgery, cardiothoracic surgery, orthopedic surgery, trauma surgery, neurosurgery, gynecology, long-term care, others, missing. Hazard ratios indicate deviation from the reference group, which is general internal medicine.

determine the prevalence of the malnutrition based on a scoring system or expert opinion because our focus was to quantify the independent effect of single nutrition related factors on outcome. Based on the cross-sectional design of the survey we can only state associations but cannot determine causalities.<sup>26</sup>

As expected, body mass index (BMI) remained in the multivariate model as a risk factor for 30-day mortality. BMI is used in most hospital systems to justify an intervention. However, somewhat differently to previous studies that found only low BMI to be associated with poor outcome,<sup>10,18,27–29</sup> our results revealed a U-shaped relationship between BMI and 30-day mortality, sometimes quoted as reverse epidemiology.<sup>30</sup> In fact, slightly obese patients with a BMI in the range of 25–40 kg/m<sup>2</sup> had on average a better outcome when compared with patients with a low or normal BMI and extremely obese patients. However, the lowest range of BMI was indeed still most strongly associated with an increased risk of death.

Weight loss in the previous 3 months, however, did not remain a key risk factor in the multivariate analysis, despite being related

**Table 4B**Multivariate analysis of the association between risk indicators and mortality ( $n = 12,727$ ).

Variable	HR (95% CI)	p-Value
<b>Patient and nutrition</b>		
<b>BMI</b>		
Underweight <18.5 kg/m <sup>2</sup> ( $n = 815$ )	1.46 (1.12–1.91)	0.004
Normal 18.5–25 kg/m <sup>2</sup> ( $n = 5331$ )	1.0	Reference
Overweight 25–30 kg/m <sup>2</sup> ( $n = 3797$ )	0.80 (0.64–1.00)	0.054
Obese 1 30–35 kg/m <sup>2</sup> ( $n = 1502$ )	0.62 (0.43–0.89)	0.010
Obese 2 35–40 kg/m <sup>2</sup> ( $n = 441$ )	0.68 (0.35–1.29)	0.238
Obese 3 >40 kg/m <sup>2</sup> ( $n = 204$ )	1.21 (0.59–2.51)	0.602
Missing ( $n = 637$ )	1.09 (0.81–1.47)	0.580
Have you lost weight unintentionally within the last 3 months?		n.s.
How well have you eaten during the last week?		
Normal ( $n = 5013$ )	1.0	Reference
A bit less than normal ( $n = 2611$ )	1.54 (1.11–2.13)	0.009
Less than half of normal ( $n = 1646$ )	2.01 (1.47–2.75)	<0.0001
Less than a quarter to nothing ( $n = 1250$ )	1.93 (1.40–2.66)	0.0001
Missing ( $n = 2207$ )	2.39 (1.63–3.50)	<0.0001
<b>Part of dish patient ate at lunch</b>		
All ( $n = 4477$ )	1.0	Reference
About 50% ( $n = 2999$ )	1.28 (0.93–1.75)	0.123
About 25% ( $n = 1323$ )	1.97 (1.42–2.71)	<0.0001
Nothing (eating allowed, $n = 644$ )	2.71 (1.88–3.91)	<0.0001
Nothing (eating not allowed/examination, $n = 898$ )	1.62 (1.03–2.53)	0.036
Missing ( $n = 2386$ )	1.90 (1.28–2.82)	0.001
<b>Number of snacks eaten during the NutritionDay</b>		
Number of snacks	0.81 (0.70–0.93)	0.0023
Missing ( $n = 3730$ )	0.98 (0.75–1.28)	0.899

to mortality in the univariate analysis. Even a weight loss of more than 5% and more than 10% was not significantly associated with the risk of dying in the multivariate analyses. There may be different reasons for this: previous weight loss is correlated with other risk factors which may mask its influence in the multivariate model, patients may not be aware of their weight changes, because regular weighing is not common, and weight loss may also be intentional before certain interventions.

The present results show that extra nutritional care was not used to a large extent, even for patients eating nothing or only a quarter of their meal. In fact, around 40% of the patients reporting that they did not eat anything had been exclusively served hospital food according to the caregivers. This suggests that either the poor nutritional intake was not detected, was not taken seriously, or that appropriate interventions were not considered necessary. Even more frightening is the finding that nearly half of all patients not allowed to eat for medical reasons received no specific artificial nutritional support. Given these findings it would appear that partial starvation is accepted as standard care in most hospitals across Europe today. A decrease in appetite was one of the most frequent reasons for patients not eating. However, decreased appetite as a barrier to adequate nutrition can be overcome by simply informing patients about the importance of eating enough.<sup>31</sup> The risk of a poor outcome simply because of undernutrition is often overlooked, and while our present study cannot determine whether or to what extent appropriate nutritional care would have modified patient outcomes, there is evidence that screening and nutritional interventions can improve these.<sup>14,29,32</sup>

#### 4.1. Limitations of the study

Results of a cross-sectional study may be affected by selection bias. We have decreased the barriers to participation by providing

questionnaires in 27 languages, not requiring any specialist skills and knowledge thereby encouraging wards with various degrees of interest in nutrition to participate. Structural data and ward specialty were considered in the multivariate analysis. In a cross-sectional survey patients with a longer length of stay are by nature more likely to be present in the survey population. This length bias was compensated in the analysis by giving more weight to patients with shorter length of stay. We considered the length of stay before NutritionDay as an additional covariable in the multivariate analyses because of the possibility that length of stay before sampling may be associated with higher disease severity. Disease severity was also considered by including several proxies for severity in the multivariate model. Cumulative incidence functions were chosen instead of Kaplan Meier curves in order to take into account the competing risk setting.

Systematically missing values in one or several parameters may bias estimates of hazard ratios. We therefore included a “missing data” category for all indicators evaluated, in order to reduce any possible hidden impact due to missing data. In fact, we found the missing category to be very informative and probably associated with a category of patients that cannot communicate well, due either to the impact of disease, concomitant neurological or psychological conditions. However, we cannot exclude that other factors have contributed to the missing category (e.g. refusal to answer after inclusion, discharge from the ward before lunch, etc).

Further limitations are related to the definitions of special diets or protein supplements. These two terms were chosen after an extensive discussion between the national partners after the pilot data acquisition. In many wards the frequently used macronutrient supplements (in the scientific literature called “oral nutritional supplements”) are qualified as “protein supplements”. Because of this lack of precision this information was also not part of the actual multivariate analysis.

We accepted a further limitation in the study design to facilitate participation: the direct data acquisition from the patients with simple questionnaires did not allow to precisely quantify total food intake over the whole day. Therefore, we separately analysed the effect of food intake per meal. Only the fraction of the served meal eaten was recorded. Whether the meal served is in accordance with the patient needs could also not be assessed. Our data do not allow assessing the effect of reduced food intake for a longer period than one day.

## 5. Conclusions

The NutritionDay Study 2006 clearly shows that decreased food intake and altered nutritional status are still a major problem within European hospitals, and that little is being done about it. Patients who do not finish their meals should be considered to be at an increased risk of acquiring a significant protein-energy deficit within few days, and that they should immediately be considered for nutritional care. We believe that fractions of the meal eaten, at least for one meal, should be considered to be included in patient charts, very much like temperature or blood pressure, because this information is easily obtained, does not require personnel specialised in nutrition, is associated with outcome and may trigger early nutritional intervention, if recorded daily. Our data do not allow recommendations how to react to decreased food intake but current evidence based guidelines from the National Institute for Clinical Excellence in the UK (NICE)<sup>17</sup> exist and recommend fortified food, additional snacks and/or sip feeds, enteral tube feeding or parenteral nutrition. Specific nutritional interventions were effective in specific clinical situations<sup>14,29</sup>; this effect was confirmed in a recent metaanalysis.<sup>33</sup> Most importantly, although the study is not designed to establish cause–effect relationship, our results

suggest that there is plenty of room for improvement and that a change of attitude about the importance of hospital nutrition is required in both patients and caregivers.

## Conflict of interest

All authors have clearly declared no conflict of interest for this project.

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