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Original article

Nutritional risk profile in a university hospital population

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SUMMARY

Background & aims: The prevalence of nutritional risk varies according to several factors. We aimed to determine the nutritional risk profile in a large Norwegian hospital population, specifically by age, disease category and hospital department.

Methods: Nutritional surveys are performed routinely at Haukeland University Hospital, Norway. During eight surveys in 2008–2009, 3279 patients were categorized according to the Nutritional Risk Screening tool (NRS 2002).

Results: The overall prevalence of nutritional risk was 29%, highest in patients with infections (51%), cancer (44%) and pulmonary diseases (42%), and in the departments of intensive care (74%), oncology (49%) and pulmonology (43%). Further, nutritional risk was identified in 40% of patients aged ≥80 years compared to 21% of age <40 years and 35% of patients with emergency admissions compared to 19% with elective admissions. Related to the tool components, nutritional risk was most common in patients with low BMI (<20.5 kg/m^2) (95%) and/or high comorbidity (>7 diagnoses) (45%). However it was also high in patients with BMI ≥25 kg/m^2 (12%) and in those with fewer than 7 diagnoses (26%).

Conclusions: Nutritional risk was most common among patients with high age, low BMI, more comorbidity, and with infections, cancer or pulmonary diseases, and patients who were discharged to nursing homes. However, the highest number of patients at nutritional risk had BMI in the normal or overweight range, were 60–80 years old, and were found in departments of general medicine or surgery. Importantly, younger patients and overweight patients were also affected. Thus, nutritional risk screening should be performed in the total patient population in order to identify, within this heterogeneous group of patients, those at nutritional risk.

1. Introduction

Results from observational studies and randomized clinical trials indicate that nutrition plays an important role in the onset and progression of disease and in rehabilitation after disease or injury [1,2]. Nutritional depletion is common in hospitalized patients due to several factors related to disease, drug therapy and limited hospital resources to recognize, prevent and treat malnutrition [3,4]. As disease-related reduction of nutritional status can result in increased morbidity, mortality and hospital costs [3,5–8], its early identification and prevention are important [9]. Low food intakes, underweight and unintentional weight loss due to illness are associated with nutritional risk [5,10]. Nutritional care upon admission to hospital can contribute to improving or maintaining nutritional status and to avoid complications throughout the hospitalization and illness period [1]. Therefore, nutritional guidelines

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recommend nutritional screening on admission to hospital [2,11]. In some countries; United Kingdom, United States, the Netherlands and parts of Denmark it is mandatory [2,3,12].

Studies have shown that 20–50% of hospitalized patients are at nutritional risk [3,13,14]. The prevalence varies according to patient groups and screening tools [10,15–18]. Using The Nutritional Risk Screening (NRS 2002), the prevalence of nutritional risk was 18% out of 32,837 medical patients in Switzerland [19] and 32% of 5051 hospitalized patients from different specialties and hospitals in Europe [20]. Nutritional routines in hospitals are not sufficient [21,22] and The Council of Europe identified five barriers to proper nutritional care in hospitals [23]; 1. Clearly defined responsibilities; 2. Sufficient education; 3. Influence he patient; 4. Co-operation between various health care groups; and 5. Involvement from hospital managers.

In Norway, prevalence surveys on nutritional risk have been performed routinely at Haukeland University Hospital since 2008. We have previously reported that nutritional risk identified with NRS 2002 predicts poorer outcomes during a 1-year follow-up study [5]. Further, we have found that implementing screening guidelines improved screening performance, but not necessarily improved nutritional interventions [24]. In this study we expand our previous studies in order to identify those patient groups, specifically by disease category and hospital department, in which nutritional risk screening would be of most value.

2. Methods

2.1. Study design

This study is based on repeated cross sectional studies conducted at Haukeland University Hospital in Norway and the three satellite hospitals Voss, Nordås and Hagavik, a total of 975 beds, in order to estimate prevalence of nutritional risk.

2.2. Repeated prevalence surveys

Prevalence surveys were repeated every three months and were part of a quality improvement project. The first prevalence survey was performed in January 2008 in 14 hospital units. The subsequent seven surveys during 2008 and 2009 included 51 units, each with 6–31 beds. On the day of registration, administrative data (age, sex and hospital ward) were recorded in a dedicated database. The screening was performed by staff nurses, as previously described [24,25]. Information about diagnoses was obtained from the patient administrative system.

2.3. Nutritional risk screening (NRS 2002)

The patient's nutritional risk was evaluated by the NRS 2002. According to this instrument the patient is classified as 'not at risk' if body mass index (BMI) is $\geq$20.5 kg/m^2, food intake is normal, weight has not been declining during the last weeks and the current illness is not severe (i.e. no increased stress metabolism). When these criteria are not met, the evaluation proceeds by giving 0–3 points in relation to BMI, recent weight loss and food intake during the previous weeks, 0–3 points according to illness severity and stress metabolism and one extra point for age >70 years. Individuals who receive $\geq$3 points are defined to be "at nutritional risk". The procedures of the screening have been described earlier [2,25]. Administrative data were obtained from the hospital's electronic administrative data system (PIMS).

2.4. Patients

Nutritional risk screening was mandatory for in-hospital patients in all departments (Table 1), except the departments of obstetrics, pediatrics and psychiatry because the NRS 2002 is not designed for these patient groups. Patients who participated in two or more surveys were included with data from the first registration only. Day-care admissions and patients without the Norwegian identification number, unique to each Norwegian resident, were not included. Other exclusion criteria were terminal care, bariatric surgery and age <18 years.

2.5. Diagnoses

The main diagnoses were categorized in groups according to the International Classification of Diseases and related health problems (ICD-10). Some common specific diagnoses such as pneumonia, acute myocardial infarction, chronic obstructive pulmonary disease (COPD), hip fracture and some cancer diagnoses, were analyzed

Table 1
Prevalence of nutritional risk, age and BMI according to hospital departments and units (n = 3279).

	Total screened				At nutritional risk					
	n	Age Mean (SD)	BMI Mean (SD)	Female n (%)	n	Prevalence Crude (95% CI)	Prevalence Adjusted (95% CI)[a]	Age Mean (SD)	BMI Mean (SD)	Female n (%)
Intensive care	57	52.1 (18.6)	26.4 (5.9)	14 (25.0)	44	78.6 (67.5–89.7)	74.4 (60.5–88.3)[b]	52.3 (18.0)	25.6 (5.7)	12 (27.3)
Oncology	259	62.5 (15.8)	24.3 (5.0)	109 (42.1)	120	46.3 (40.2–52.5)	48.6 (42.5–54.8)	65.5 (13.8)	21.9 (4.5)	59 (49.2)
Thoracic medicine	176	70.2 (15.0)	23.1 (5.4)	82 (46.6)	77	43.8 (36.4–51.1)	42.8 (34.7–51.0)	71.4 (13.6)	19.1 (3.4)	35 (45.5)
Otolaryngology	103	58.5 (20.0)	24.2 (4.9)	36 (35.0)	36	35.0 (25.6–44.3)	40.1 (30.8–49.4)	70.3 (15.9)	19.9 (3.3)	12 (33.3)
General medicine	490	64.9 (20.3)	24.8 (5.7)	229 (46.7)	195	39.8 (35.5–44.2)	39.6 (35.1–44.1)	67.0 (20.4)	21.3 (4.6)	101 (51.8)
General surgery	600	64.2 (18.0)	24.8 (5.1)	305 (50.8)	185	30.8 (27.1–34.5)	30.5 (26.9–34.1)	69.3 (16.8)	21.4 (4.4)	108 (58.4)
Cardiology	402	66.7 (15.9)	26.1 (5.3)	151 (37.6)	109	27.1 (22.8–31.5)	27.0 (22.4–31.4)	72.2 (15.9)	23.5 (5.8)	50 (45.9)
Rheumatology	108	67.3 (14.6)	25.3 (5.4)	78 (72.2)	24	22.2 (14.3–30.2)	25.4 (14.5–36.2)	67.1 (18.6)	20.9 (5.3)	17 (70.8)
Neurosurgery	105	55.7 (17.2)	24.7 (3.8)	51 (48.6)	23	21.9 (13.9–30.0)	24.6 (14.8–34.4)	60.8 (14.4)	21.5 (3.4)	13 (56.5)
Neurology	212	60.0 (18.7)	25.4 (5.1)	108 (50.9)	42	19.8 (14.4–25.2)	20.4 (15.0–25.9)	66.1 (18.4)	20.8 (4.4)	28 (66.7)
Orthopedic/traumatology	278	64.8 (19.8)	25.5 (5.7)	157 (56.5)	60	21.6 (16.7–26.5)	18.8 (14.6–23.0)	74.9 (15.5)	20.0 (4.7)	48 (80.0)
Dermato-venereology	57	64.3 (18.4)	28.8 (6.6)	30 (52.6)	6	10.5 (2.3–18.7)	12.2 (4.1–20.2)	76.2 (11.8)	21.9 (6.0)	3 (50.0)
Habilitation/rehabilitation	151	55.7 (15.1)	25.8 (5.0)	58 (38.4)	12	7.9 (3.6–12.3)	7.5 (3.5–11.6)[b]	57.6 (16.1)	19.9 (2.7)	6 (50.0)
Gynecology	115	57.0 (18.4)	26.1 (5.1)	115 (100.0)	8	6.7 (2.2–11.7)	7.0 (2.1–11.9)[b]	50.9 (22.4)	20.9 (6.2)	8 (100.0)
Orthopedic (elective)	152	64.8 (15.2)	27.9 (5.3)	100 (65.8)	11	7.2 (3.1–11.4)	6.4 (2.7–10.1)	74.7 (16.3)	18.9 (1.1)	9 (81.8)
Ophthalmology	15	63.3 (17.8)	27.5 (5.6)	9 (60.0)	0	0	0			
Total	3279	63.4 (18.1)	25.3 (5.4)	1632 (49.8)	952	29.0 (27.5–30.1)		67.8 (17.6)	21.4 (4.8)	509 (53.5)

[a] Adjusted for age and sex using a direct standardized method.
[b] Adjusted for age.

separately (see Appendix 1). When the patient had two or more diagnoses, the most relevant diagnosis for the hospitalization was reported by the responsible physician as the main diagnosis.

2.6. Statistical analyses

Continuous variables were categorized, and reported as percentages ± standard error of the mean (SEM). The prevalence of nutritional risk was estimated overall as well as according to disease categories and hospital departments. To allow comparison between disease categories (or hospital departments), prevalence estimates and the corresponding 95% confidence intervals were adjusted for age and sex using a direct standardization method [26]. For this method, firstly, the total population ($n = 3279$) was considered as a standard and was distributed into six possible combinations of age (18–59, 60–79, 80+ years) and sex. For each combination, we estimated the relative frequency or weight (w) from the total population. If one or more cells of the combination variables were empty ($n = 0$), we excluded sex and only standardized for age. Second, the crude prevalence (p) of nutritional risk was estimated for each combination of age, sex, and disease categories (or hospital departments). Finally, the adjusted prevalence of nutritional risk within disease categories (or hospital departments) was defined as the weighted average of the respective prevalence p, weighted by w [27].

The standardization method was performed by using the *dstdize* function in Stata/IC 12.0 for Windows, otherwise statistical analyses were carried out using the statistical software SPSS Version 21.0 (SPSS Inc., Chicago, Illinois).

2.7. Ethics

The Norwegian Data Inspectorate and the hospital research board approved the study, which was exempted from review by the Regional Committee for Medical and Health Research Ethics because it was part of a quality improvement project to improve the nutrition care of hospitalized patients. The prevalence surveys were performed routinely in the hospital. Screening for nutritional risk is mandatory for the patients. The patients were not asked to provide informed consent and were not subject to any experimental interventions. Only clinical data available in the patient administrative system of the hospital were used.

3. Results

3.1. Study population

The flow-chart (Fig. 1) presents the numbers of patients eligible for screening, and who were actually screened. Among the 3962 eligible patients at the eight surveys, 3279 (83%) patients were completely assessed by the NRS 2002 and categorized as being at nutritional risk ($n = 952$, 29%) or not at risk ($n = 2327$, 71%). There was no information available on the 683 patients who were not completely screened.

3.2. General characteristics

Characteristics of the patients are presented in Table 2 and Fig. 2. The study population consisted of 50% men; mean age was 63.0 years and mean BMI 25.3 kg/m^2. Among patients at nutritional risk 53% were women; mean age was 67.8 years and mean BMI 21.4 kg/m^2. The prevalence of nutritional risk increased with age (Fig. 2) and was 40% for patients ≥80 years compared to 21% for patients <40 years (Table 2).

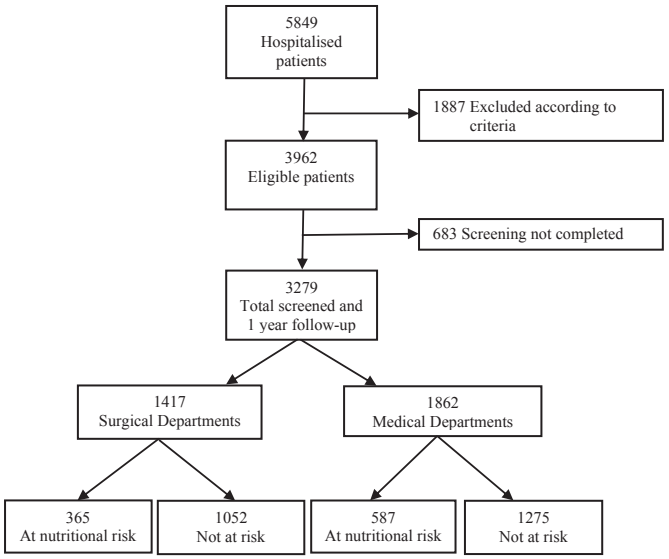

Fig. 1. Flow-chart: results from the eight prevalence surveys.

As might be expected based on the scoring system, the occurrence of nutritional risk was associated with weight; 95% of underweight (BMI <20.5 kg/m^2) patients were at risk. However, 12% of overweight (BMI ≥25 kg/m^2) and 11% of obese (BMI ≥30 kg/m^2) patients were also at nutritional risk (Table 2).

Again as might be expected, compared to patients not at risk, the patients at nutritional risk had more diagnoses (12% versus 25% had more than 7 diagnoses) and also more often emergency admissions (55% versus 74%).

3.3. Diagnoses

The prevalence of nutritional risk was at least 9% in all main categories of the ICD-10 system, and highest among patients with infections (51%), cancers (44%) and pulmonary diseases (42%); see Table 3 and in more detail in Appendix 1. However, cancers and diseases of the circulatory system are the most common categories

Table 2
Characteristics of the study population.

	Eligible patients *n* (%)	Total screened *n* (%)	At nutritional risk	
			n	% (±SEM)
Total	3962 (100.0)	3279 (82.8)	952	29.0 (±0.8)
Gender				
Female	1970 (49.7)	1632 (82.8)	509	31.2 (±1.1)
Male	1992 (50.3)	1647 (82.7)	443	26.9 (±1.1)
Age (years)				
18–39	475 (12.0)	407 (85.7)	87	21.4 (±2.0)
40–59	982 (24.8)	825 (84.0)	177	21.5 (±1.4)
60–79	1636 (41.3)	1331 (81.4)	399	30.0 (±1.3)
≥80	869 (21.9)	716 (82.4)	289	40.4 (±1.8)
Number of diagnoses (*n*)				
1–3	1593 (40.2)	1371 (86.1)	238	17.4 (±1.0)
4–7	1424 (35.9)	1386 (97.3)	478	34.5 (±1.3)
>7	945 (23.9)	522 (55.2)	236	45.2 (±2.2)
BMI (kg/m^2)				
<20.5	Data not available	548	522	95.3 (±0.9)
20.5–24.9		1135	229	35.5 (±1.4)
25.0–29.9		993	131	13.2 (±1.1)
30.0–34.9		363	42	11.6 (±1.7)
35.0–39.9		113	10	8.8 (±2.7)
≥40.0		48	6	12.5 (±4.8)
Admissions				
Elective	1492 (37.7)	1293 (86.7)	249	19.3 (±1.1)
Emergency	2470 (62.3)	1986 (80.4)	703	35.4 (±1.1)

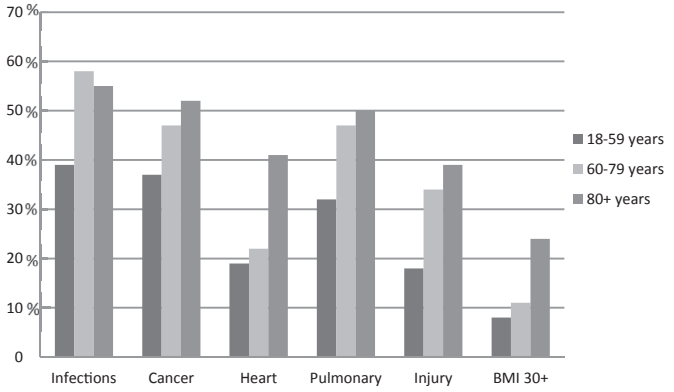

Fig. 2. Prevalence of nutritional risk in different categories of age and diseases (ICD-10).

of the main diagnoses in this hospital, accounting for 37% of the study population. Near half of the patients who were categorized as being at nutritional risk had diagnoses belonging to one of these two groups, i.e., 32% with cancer and 15% with a circulatory disorder (ICD-10-code I00-I99).

Patients with cancer in the gastrointestinal, pulmonary and lymphoid systems had the highest occurrence of nutritional risk (60%, 58% and 50%, respectively). For patients with diseases in the circulatory system (overall prevalence of nutritional risk 27%), a higher prevalence was observed in those with heart failure (46%) versus acute myocardial infarction (26%) and cerebral stroke (25%). Among patients with pulmonary diseases, the highest prevalence of nutritional risk was seen in patients with pneumonia (49%) and chronic obstructive pulmonary disease (COPD) (36%).

Overall, one third of the patients with diseases of the digestive system (K00–K93) were at nutritional risk. The prevalence was highest among patients with inflammatory bowel diseases (56%), celiac disease (50%) and diseases in esophagus, stomach and duodenum (48%).

The prevalence of nutritional risk was 37% among patients with hip fracture compared with 14% in those with an upper extremity fracture. Results for some other single diagnoses are shown in the appendix.

Adjustment for age and sex did not change the main findings (Table 3).

3.4. Departments and units

The prevalence of nutritional risk was significantly higher in departments of medicine (32%) than in departments of surgery (26%) ($p < 0.001$). In medical departments, nutritional risk was most common in the units of oncology (49%), pulmonology (43%), and general medicine (40%). Most (72%) of the 587 patients at nutritional risk in medical departments were found in three units; general medicine ($n = 195$), oncology ($n = 120$), and cardiology ($n = 109$).

The prevalence of nutritional risk in surgical departments was highest in intensive care units (74%), department of otolaryngology (40%) and general surgery (39.6). The relatively high nutritional risk for admissions to the otolaryngeal department was attributable to cancer (48%). Half of the surgical patients at nutritional risk had been admitted to general surgery departments.

3.5. Discharge from hospital

Of the total 3279 patients, 2552 (78%) were discharged from hospital to their own homes and 641 (20%) to nursing homes or to other hospitals, while 85 (3%) died in hospital. Of those patients who were discharged from hospital to home, 25% were at nutritional risk compared with 41% of those who were discharged to nursing homes, and 77% of those who died at the hospital.

4. Discussion

In this study of 3279 patients at Haukeland University Hospital the highest prevalence of nutritional risk was found among patients ≥80 years of age, BMI <20.5 kg/m^2 and among those with multi morbidity (>7 diagnoses). Further, the prevalence was high among patients with infections, cancer and pulmonary diseases. However, at this hospital, most of the patients at nutritional risk were not underweight, had four to seven diagnoses and were 60–80 years old. Even the younger patients, obese patients and patients with few diagnoses were frequently found to be at nutritional risk.

The prevalence of nutritional risk was highest in the intensive care unit and in oncology and pulmonology units; nevertheless, most of the patients at nutritional risk were located in departments of general medicine or surgery. In patients with myocardial infarction, where overweight is a risk factor, one out of

Table 3
Nutritional risk, age and BMI according to main diagnoses (ICD-10).

	Total screened				At nutritional risk					
	n	Age Mean (SD)	BMI Mean (SD)	Female *n* (%)	*n*	Prevalence Crude (95% CI)	Prevalence Adjusted (95% CI)[a]	Age Mean (SD)	BMI Mean (SD)	Female *n* (%)
Infections (A00–B99)	91	62.5 (19.7)	25.3 (7.0)	55 (60.4)	45	49.5 (39.0–60.0)	50.7 (40.4–61.0)	66.3 (18.9)	22.4 (5.4)	25 (55.6)
Cancer (C00–D48)	683	64.8 (15.3)	24.3 (5.0)	303 (44.4)	301	44.1 (40.3–47.8)	44.0 (40.2–47.7)	67.1 (14.6)	21.5 (4.1)	134 (44.5)
Pulmonary diseases (J00–J99)	276	67.5 (19.0)	23.7 (5.3)	125 (45.3)	120	43.5 (37.6–49.4)	41.8 (36.0–47.6)	70.8 (17.5)	20.5 (5.0)	58 (48.3)
Endocrine disorders (E00–E90)	35	56.0 (19.8)	27.0 (8.3)	24 (68.6)	10	28.6 (12.8–44.3)	37.6 (21.9–53.3)	68.1 (20.2)	20.0 (2.9)	7 (70.0)
Digestion diseases (K00–K93)	225	57.9 (20.7)	25.1 (5.4)	118 (52.4)	79	35.1 (28.8–41.4)	36.5 (29.8–43.2)	60.7 (21.0)	22.1 (5.7)	46 (58.2)
Injury (S00–S99)	286	67.3 (20.3)	24.2 (4.9)	173 (60.5)	87	30.4 (25.1–35.8)	27.6 (22.3–33.0)	72.4 (18.5)	20.3 (3.7)	58 (66.7)
Circulatory diseases (I00–I99)	546	67.8 (15.6)	25.8 (5.0)	210 (38.5)	144	26.4 (22.7–30.1)	27.2 (23.1–31.3)	71.9 (16.6)	22.6 (5.2)	80 (55.6)
Uro-genitalia (N00–N99)	138	65.6 (18.3)	25.8 (4.9)	92 (66.7)	22	15.9 (9.8–22.1)	16.9 (8.3–25.5)	73.8 (15.7)	22.5 (6.4)	13 (59.1)
Abnormal findings, not elsewhere classified (R00–R99)	71	55.7 (20.6)	24.9 (4.5)	37 (52.1)	11	15.5 (6.9–24.1)	15.4 (5.9–24.8)	57.8 (25.7)	19.2 (3.3)	7 (63.6)
Neurological diseases (G00–G99)	98	56.1 (17.7)	25.9 (5.0)	45 (45.9)	13	13.3 (6.4–20.1)	13.1 (6.1–20.0)	63.6 (14.8)	19.5 (4.2)	8 (61.5)
Skin and subcutaneous tissue (L00–L99)	74	60.3 (19.3)	27.9 (6.5)	38 (51.4)	9	12.2 (4.5–19.8)	13.0 (5.6–20.3)	64.3 (20.9)	23.0 (7.7)	5 (55.6)
Musculoskeletal and connective tissue (M00–M99)	307	61.6 (17.5)	26.8 (5.2)	178 (58.0)	31	10.1 (6.7–13.5)	10.6 (7.1–14.1)	65.3 (21.3)	21.9 (5.5)	20 (64.5)
Diseases of the blood, blood-forming organs and immune (D50–D89)	18	66.9 (19.0)	26.1 (6.2)	12 (66.7)	3	16.7 (2.4–35.7)	9.1 (0.2–18.1)	79.7 (3.0)	20.4 (4.6)	3 (100.0)
Total	3279	63.4 (18.1)	25.3 (5.4)	1632 (49.8)	952	29.0 (27.5–30.1)		67.8 (17.6)	21.4 (4.8)	509 (53.5)

[a] Adjusted for age and sex using a direct standardized method.

four patients were found to be at nutritional risk. Nearly half of the patients discharged from hospital to nursing homes were at nutritional risk.

4.1. Comparisons with findings from other studies

The prevalence of nutritional risk increases with age as has also been shown in previous studies [1,13,19,28]; 40% among patients ≥80 years old. NRS 2002 gives one extra point for age 70 years and older, because older people may have a lower tolerance for reduced nutritional status. Compared to younger patients, older people in hospitals generally have more comorbidity and polypharmacy that affect appetite, food intake and absorption of nutrients from the gastrointestinal tract. Without adding the point for age in NRS 2002, the prevalence of nutritional risk would have been 29% for patients' ≥80 years and 25% for patients 60–79 years old.

Nutritional risk has been shown to be most common in departments of gastrosurgery, cancer, infections, pulmonary, cardiac, and other chronic diseases [14,29–31]. However, in this study, the prevalence of nutritional risk was high in all illness categories, even among patients admitted for overweight-related conditions, such as acute myocardial infarction and stroke. It is demonstrated in previous studies using subjective global assessment (SGA) that malnutrition is common among overweight and obese patients as well [29,32]. In this study, as much as 12% of the overweight and obese were at nutritional risk. Hence awareness of nutrition due to disease-related stress metabolism and elevated protein needs is relevant to all patients, independent of BMI.

In the present study, the departments of gynecology, elective surgery and rehabilitation had low prevalence of nutritional risk and the unit of ophthalmology had no patients identified to be at nutritional risk. This was apparently due to low levels of general morbidity, lack of illnesses with stress metabolism, and younger patients in these units.

4.2. Methodological considerations

The strength of the present study is the relatively large number of patients and that the data were collected as part of hospital-wide prevalence surveys. Prevalence surveys can be of paramount significance for improvement of nutritional management of hospital patients. They show the burden of the problem to the health care managers and politicians, and may sensitize the participating hospital staff to nutritional issues, in particular to the need of nutritional interventions.

A screening tool should be practical, reliable and evidence-based [28]. The NRS 2002 was chosen because it fulfilled these criteria, and it has been validated and is recommended by the European Society for Nutrition and Metabolism (ESPEN) for use in hospitals [2]. NRS2002 is designed to be used in all adult patient categories in somatic hospital wards [10]. However, its usefulness in the Intensive care unit (ICU), were almost all patients get a score of 3 or more due to illness, is debatable. In this survey, 25 out of 57 patients at ICU got four points or more. The conclusion from the EPaNIC study [33] that the ICU patient benefits from less energy, at least i.v., during the early phase of disease has started a debate among nutritionists concerning nutritional management of the ICU patient. The advice in guidelines is also contradictory as early (on day 3) i.v., nutrition is advocated by ESPEN and late (after 8 days) by ASPEN [33] if enteral nutrition fails. Throughout this discussion it should be kept in mind that the clinical rationale for screening is to initiate tailored nutritional treatment to improve outcome.

On the one hand, patients with decreased consciousness and/or who were severely ill were more likely *not* to be screened. One the other hand, the healthiest patients stay at the patient hotel and might be less available for participating in the survey. If the healthiest and the sickest more often were not to be screened, our estimate of the prevalence of nutritional risk probably represents a middle estimate for hospital populations.

A limitation of the study is that psychiatric patients and patients below 18 years old were excluded, and 17% of eligible patients were not screened. However, patients were assessed by the nurses who were responsible for each patient during hospitalization; hence the assessment was performed by the person who knew the patient best.

4.3. Clinical implications

When patients are identified as being at nutritional risk, evidence-based treatment should be introduced to improve clinical outcomes. Our effort to improve patients' outcomes by nutritional treatment needs further action. In this study, patient groups for whom nutritional care would be of most value were identified. However, we found that patients at nutritional risk were a heterogeneous group and were admitted to almost all hospital units, many disease categories, wide categories of age and BMI, and with a single, few or several diagnoses. The heterogeneity of the patients indicates that it is not possible to identify at risk patients without nutritional risk screening or assessment. Hence routine screening on admission according to guidelines appears essential. These repeated nutrition surveys have revealed important data on prevalence and can improve screening performance and remind staff to accord nutrition an appropriate priority [24].

As many as one of four patients, discharged to their own home, and 40% of the patients, discharged to nursing homes, were at nutritional risk. Adequate transmission of information about nutritional status and intervention from the hospital to the GPs, home care services and nursing homes is important. According to a Dutch study, systematic transfer of relevant nutritional information from the hospital to the primary health career is fragmentary or lacking [13], and this may also be the case in our hospital. Improved reporting of patients' nutritional status, their nutritional plan and goals is an important opportunity for the hospitals to improve health care quality. In countries without dietitians to follow up patients after hospital discharge, as in Norway, the quality of the discharge letters is even more essential [1,6].

4.4. Implications for further research

Clinical studies should be conducted to assess whether structured nutritional work in a hospital organization is effective at improving patients' care, nutritional status and outcomes [34]. Studies of the efficiency and practice of nutritional interventions in different medical and surgical specialties are required.

5. Conclusion

The highest prevalence of nutritional risk was found among the oldest patients, patients with BMI <20.5, multi morbidity, emergency admissions, infections, cancer and pulmonary diseases. However, the largest number of patients at nutritional risk had BMI >20.5, four to seven diagnoses, were 60–80 years old or had been admitted to departments of general medicine or surgery. Nearly half of the patients discharged from hospital to nursing homes were at nutritional risk. Our study reveals that patients at

nutritional risk are heterogeneous and we recommend nutritional screening for all hospital patients.

Statement of authorship

RJT, GST, ABG participated in developing the nutritional strategy. RJT, GST, ABG and AHR participated in the conception and design of the study. All the authors participated in the interpretation of the data, contributed to writing the manuscript and the final approval of the submitted version. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Conflict of interest

The authors, the Kavli Research Centre for Ageing and Dementia and The Western Norway Regional Health Authority have no conflicts of interest to declare. The sponsors of this study had no role in the study design, data collection, data analyses, data interpretation, or writing the report. All authors have completed the Unified Competing Interest form and declare that (1) no one have support from any for the submitted work; (2) none of the authors have any relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) nor their spouses, partners, or children have any financial relationships that may be relevant to the submitted work; and (4) no one have any non-financial interests that may be relevant to the submitted work.

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Appendix 1. Prevalence of nutritional risk according to main diagnoses (ICD-10).

	Total screened *n*	At nutritional risk *n*	Prevalence Crude (95% CI)
Infections (A00–B99)	91	45	49.5 (39.0–60.0)
Sepsis (A40–41)	52	29	55.6 (41.8–69.7)
Cancer (C00–D48)	683	301	44.1 (40.3–47.8)
Lip, oral cavity, pharynx and digestive organs (C00–C26)	172	103	59.9 (52.5–67.3)
Colon, rectum, anus and anal canal (C18–C21)	72	32	44.4 (32.7–56.2)
Respiratory and intrathoracic organs (C30–C39)	59	34	57.6 (44.6–70.6)
Lymphoid, hematopoietic and related tissues (C80–C96)	90	45	50.0 (39.5–60.5)
Sec. neoplasm of lymph nodes, respiratory. and digestive organs (C77–C79)	109	56	51.4 (41.8–60.9)
Central nervous system and endocrine glands (C69–C75)	25	8	32.0 (12.4–51.7)
Breast (C50)	17	5	29.4 (5.3–53.6)
Genital organs and urinary tract (C51–C68)	94	19	20.2 (11.9–28.5)
Prostate (C61)	29	9	31.0 (13.1–48.9)
Bladder (C67)	22	4	18.2 (0.7–35.7)
Pulmonary diseases (J00–J99)	276	120	43.5 (37.6–49.4)
Pneumonia (J12–J18)	129	63	48.8 (40.1–57.6)
COPD (J40–J47)	39	14	35.9 (20.1–51.7)
Diseases of the digestive system (K00–K93)	225	79	35.1 (28.8–41.4)
Diseases of esophagus, stomach and duodenum (K20–K31)	25	12	48.0 (27.0–69.1)
Inflammatory bowel diseases (K50–K52)	27	15	55.6 (35.5–75.6)
Liver (K70–K77)	10	3	30.0 (−4.6–64.6)
Gall bladder and pancreas (K80–K87)	45	15	33.0 (19.0–47.7)
Celiac disease, malabsorption (K90–K93)	8	4	50.0 (5.3–94.7)
Endocrine, nutritional and metabolic diseases (E00–E90)	35	10	28.6 (12.8–44.3)
Injury (S00–S99)	286	87	30.4 (25.1–35.8)
Hip fracture (S70–S72)	95	35	36.8 (27.0–46.7)
Abdomen, lower back, lumbar spine, pelvis (S30–S32)	31	10	32.3 (14.8–49.7)
Shoulder, upper arm and forearm (S42–S52)	48	14	29.2 (15.8–42.5)
Diseases of the circulatory system (I00–I99)	546	144	26.4 (22.7–30.1)
Stroke (I60–I69)	119	30	25.2 (17.3–33.1)
Heart diseases (I11, I20–25, I30–I52)	348	91	26.2 (21.5–30.8)
Heart failure (I50)	48	22	45.8 (31.2–60.5)
Acute myocardial infarction (I21–I25)	100	26	26.0 (17.3–34.8)
Angina pectoris (I20)	62	4	6.5 (0.2–12.7)
Symptoms and abnormal findings, not elsewhere classified (R00–R99)	71	11	15.5 (6.9–24.1)
Diseases of the genitourinary system (N00–N99)	138	22	15.9 (9.8–22.1)
Renal failure (N17–N19)	30	8	26.7 (9.9–43.5)
Urinary tract infection (N39)	22	5	22.7 (3.7–41.8)
Glomerular and renal tubulo-interstitial diseases (N00–N16)	10	3	30.0 (−4.6–64.6)
Diseases of the blood, blood-forming organs, disorders involving the immune mechanism (D50–D89)	18	3	16.7 (2.4–35.7)
Diseases of the nervous system (G00–G99)	98	13	13.3 (6.4–20.1)
Diseases of the skin and subcutaneous tissue (L00–L99)	74	9	12.2 (4.5–19.8)
Diseases of the musculoskeletal and the connective tissue (M00–M99)	307	31	10.1 (6.7–13.5)
Rehabilitation (Z50.80–Z50.89)	189	28	15.1 (9.9–20.2)
Total	3279	952	29.0 (27.5–30.1)

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