



Epidemiology

Large regional disparities in prevalence, management and reimbursement of hospital undernutrition

Saman Khalatbari-Soltani^{1,2} · Carlos de Mestral¹ · Gérard Waeber² · Pedro Marques-Vidal²

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Abstract

Background/Objectives Undernutrition is a frequent condition among hospitalized patients, with a significant impact on patient's outcome and hospital costs. Whether undernutrition is reported similarly at the national level has seldom been assessed. We aimed to (1) assess regional differences within Switzerland regarding undernutrition prevalence, management, and cost reimbursement and (2) identify the factors associated with reporting of undernutrition status and its management. **Subjects/Methods** Observational cross-sectional study including routine statistics from the Swiss hospital discharge databases for years 2013 and 2014 (seven administrative regions). All adults aged ≥ 20 with length of hospital stay of at least 1 day was included. Reported undernutrition was defined based on the International Classification of Diseases (ICD)-10 codes. Nutritional management and "reimbursable" undernutrition codes were also assessed.

Results Of the initial 1,784,855 hospitalizations, 3.6% had reported undernutrition, the prevalence ranging between 1.8% (Ticino) and 4.6% (Mittelland). Use of different undernutrition-related ICD-10 codes also varied considerably across regions. Multivariable analysis showed a twofold variation in reported undernutrition: multivariable-adjusted odds ratio and 95% confidence interval relative to Eastern Switzerland: 2.31 (2.23, 2.38) for Mittelland and 0.74 (0.70, 0.79) for Ticino. Over half (59.6%) of hospitalizations with reported undernutrition also included information on undernutrition management, ranging between 28.6% (Ticino) and 67.2% (Zürich). Only one third (36.8%) of undernutrition-related codes were reimbursable, ranging between 8.3% (Ticino) and 50.7% (Zürich).

Conclusions In Switzerland, there is considerable regional variation regarding reporting of undernutrition prevalence, management, and cost reimbursement. Undernutrition appears to be insufficiently managed and valued.

Introduction

Undernutrition is a common condition among hospitalized patients, which adversely affects health outcomes. Undernutrition increases length of hospital stay (LOS), morbidity, mortality, and hospital costs [1]. Still, hospital

undernutrition tends to be under-diagnosed and improperly addressed [2, 3].

Studies at the national level assessing undernutrition prevalence among adult hospitalized patients are scarce. In the Netherlands, two multicenter studies reported undernutrition prevalence levels of 14% and 32% among half a million and 12,883 hospitalized patients, respectively [4, 5]. One nationally representative study in the United States reported that 3.4% of hospital discharges had undernutrition-related codes [6]. A study conducted in the United Kingdom reported that 25% of patients screened at admission were at medium or high risk of undernutrition [7]. Studies regarding the economic impact of undernutrition at the national level are also scarce [8, 9], and indicate that undernutrition is a costly condition. Hence, adequate reporting of nutritional status of patients and its management in hospital discharge data are important for public health (to calculate proper rates and to evaluate performance of hospitals), allocation of resources (i.e., an increase in the number of undernourished patients should be

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✉ Saman Khalatbari-Soltani
Saman.KhalatbariSoltani@unil.ch
Saman.khalatbari@gmail.com

¹ Institute of Social and Preventive Medicine (IUMSP), Lausanne University Hospital, Biopole 2, Route de la Corniche 10, CH-1010 Lausanne, Switzerland

² Department of Medicine, Internal Medicine, Lausanne University Hospital (CHUV), rue du Bugnon 46, 1011 Lausanne, Switzerland

counteracted by an increase in the number of clinical nutrition professionals), and hospital reimbursement rates [10].

Switzerland is a small European country with universal health coverage based on mandatory individual health insurance [11]. The country consists of 26 cantons, which have a large autonomy regarding health planning. Hence, guidelines regarding undernutrition screening and management are not implemented at the national level, although efforts have been made for such harmonization for reimbursement purposes [12]. Several studies regarding prevalence and cost of undernutrition have been conducted in specific settings [1, 13], but none at the national level. Thus, the primary aim of this study was to assess any geographical differences regarding prevalence of reported undernutrition, management, and cost reimbursement. The secondary aim was to assess the factors associated with reporting of undernutrition status and its management.

Methods

Study sample

Data from the Swiss hospital discharge database for years 2013–2014 were used. The database was provided by the Swiss federal office of statistics (<http://www.bfs.admin.ch>); it covers 98% of public and private hospitals within Switzerland and includes all stays for each hospital. The main cause for hospitalization and the comorbidities are coded using the International Classification of Diseases 10th revision (ICD-10) of the World Health Organization. The procedures are coded using the Swiss classification of surgical interventions (CHOP) (<http://www.bfs.admin.ch>), which also includes non-surgical interventions such as dietary management.

Eligibility criteria were as follows: adult patients (aged ≥ 20 years), length of hospital stay >1 day, not having any codes related to pregnancy, childbirth, and the puerperium (i.e., ICD-10 codes beginning with letter “O”) as main diagnosis, having complete demographic data and information on main diagnosis and mortality. As it was not possible to identify patients, the results relate to the number of discharges and not to the number of patients. Due to Swiss data protection legislation, ages were provided in categories, hence, it was not possible to include hospitalizations for patients aged 18 or 19.

Prevalence and management of undernutrition

Presence of undernutrition was assessed by searching all ICD-10 codes related to nutritional status: E12 (malnutrition-related diabetes mellitus), E40 (kwashiorkor), E41

(nutritional marasmus), E42 (marasmic kwashiorkor), E43 (unspecified severe protein-energy malnutrition), E44 (protein-energy malnutrition of moderate and mild degree), E46 (unspecified protein-energy malnutrition), R63 (R63.0: anorexia, R63.3: feeding difficulties and mismanagement; R63.4: abnormal weight loss, and R63.6: insufficient intake of food and water due to self-neglect), and R64 (cachexia).

Presence of nutritional management was assessed by searching all CHOP codes related to enteral nutrition (96.6 and 96.35), parenteral nutrition (99.15), nutritional advice and therapy (89.0 A.32), and multimodal nutritional therapy (89.0 A.4*, where * = any number). Multimodal nutritional therapy can be coded when management is performed by a specialized team including a specialist doctor, a nurse and a dietician, and includes nutritional evaluation, several meetings to adapt nutritional management, and adequate nutritional documentation in the medical file.

Presence of “reimbursable” undernutrition was assessed by searching specific associations of undernutrition-related ICD-10 (E43 and E44) and nutritional management CHOP codes [12].

Demographic and socio-economic variables

The following variables were extracted: administrative region, year of hospital discharge, sex, nationality (Swiss/non-Swiss), age group (categorized into 20–39, 40–64, and ≥ 65 years), main diagnosis at discharge and comorbidities (based on ICD-10 codes, Supplemental Table 1) and stay in an intensive care unit (ICU, yes/no). Administrative region was categorized into Eastern, Léman, Mittelland, Northwest, Zürich, Central, and Ticino based on similar linguistic and cultural characteristics, as previously done [14]. Severity of disease was assessed using the Swiss version of the Charlson Comorbidity Index (CCI) and dichotomized into low ($CCI < 2$) and high ($CCI \geq 2$) comorbidity status [15].

Statistical analysis

Statistical analyses were performed using Stata 14 (Stata Corp, College Station, TX, USA). Bivariate analyses were performed using χ^2 -test for categorical variables. Results were expressed as number of participants (percentage) or as average \pm standard deviation. Multivariable analysis was performed using logistic regression and results were expressed as odds ratio (OR) and 95% confidence interval (CI). All models were adjusted for year of admission, sex, age categories, nationality, main disease categories, ICU stay, and CCI category.

Hospital discharges were further weighted based on sex and age categories distribution of the Swiss population for

Table 1 Demographic and clinical characteristics of the study population by administrative region, Swiss hospital discharge database, 2013–2014

Characteristics	Eastern (n = 272,977)	Léman (n = 298,815)	Mittelland (n = 339,629)	Northwest (n = 342,134)	Zürich (n = 306,359)	Central (n = 133,121)	Ticino (n = 91,820)	P-value
<i>Age group, years</i>								<0.001
20–39	14.5	13.7	12.6	12.7	16.4	15.2	7.9	
40–64	52.4	47.4	48.5	49.9	50.4	52.9	44.3	
Above 65	33.1	38.9	39.9	37.4	33.2	31.9	47.8	
<i>Sex</i>								<0.001
Man	49.1	46.0	47.0	47.6	48.0	50.4	45.6	
Woman	50.9	54.0	53.0	52.4	52.0	49.6	54.4	
<i>Nationality</i>								<0.001
Swiss	81.9	72.6	89.3	80.8	79.9	84.5	73.0	
Non-Swiss	18.1	27.4	10.7	19.2	20.1	15.5	26.9	
<i>Main diagnosis</i>								<0.001
Malignant	7.3	9.4	8.3	8.7	9.4	7.5	9.9	
Circulatory system	11.7	11.4	12.4	12.0	11.0	9.9	12.6	
Respiratory system	5.5	6.2	5.4	5.8	4.8	5.6	6.9	
Digestive system	10.7	9.2	10.3	10.0	11.2	11.5	9.9	
Infectious	2.5	2.5	3.2	3.0	2.9	3.1	3.0	
Mental and nervous system	13.3	13.5	12.2	12.2	12.1	11.9	11.6	
Miscellaneous	49.0	47.8	48.2	48.3	48.6	50.5	46.1	
<i>Intensive care unit</i>								<0.001
No	94.5	91.5	93.8	93.5	91.6	91.1	92.4	
Yes	5.5	8.5	6.2	6.5	8.4	8.9	7.6	
<i>Charlson index</i>								<0.001
0–1	79.9	75.1	74.5	76.3	75.6	78.3	71.7	
2+	20.1	24.9	25.5	23.7	24.4	21.7	28.3	

Results are expressed as column weighted percentage. Between-group comparisons performed using χ^2 -test. Results are weighted based on sex and age categories distribution of the Swiss population for years 2013 and 2014

2013 and 2014; data were downloaded from the Swiss federal office of statistics. To reduce the likelihood of type I error due to the high number of tests performed, we considered statistical significance for two-sided tests at $p < 0.01$. We present the results only for undernutrition-related ICD-10 codes with prevalence $\geq 2\%$, which we arbitrarily set as the clinically relevant cutoff.

Code availability

Stata code used in the statistical analysis can be provided upon request.

Ethics statement

The hospital discharge data provisions are part of a Swiss government mandate and no agreement from an ethics committee is necessary. All data were anonymized prior to being used.

Results

Sample selection and characteristics

Of the initial 2,404,545 hospitalizations, 1,784,855 (74.2%) were included in the analysis (Supplemental Fig. 1). Excluded hospitalizations were more likely to be of younger adults, women, Swiss, no ICU stay, low CCI and patients from Léman, Mittelland and Zürich (Supplemental Table 2). Table 1 summarizes the demographic and clinical characteristics of the included hospitalizations by administrative region. Hospitalizations in Ticino were older (≥ 65 years), Léman and Ticino had slightly higher proportion of women and non-Swiss hospitalizations. Central Switzerland had the highest proportion of ICU stay and Ticino had the highest proportion of hospitalization with CCI ≥ 2 (Table 1). Results from the raw data (un-weighted) as a sensitivity analysis showed no differences in comparison with the aforementioned results (Supplemental Table 3).

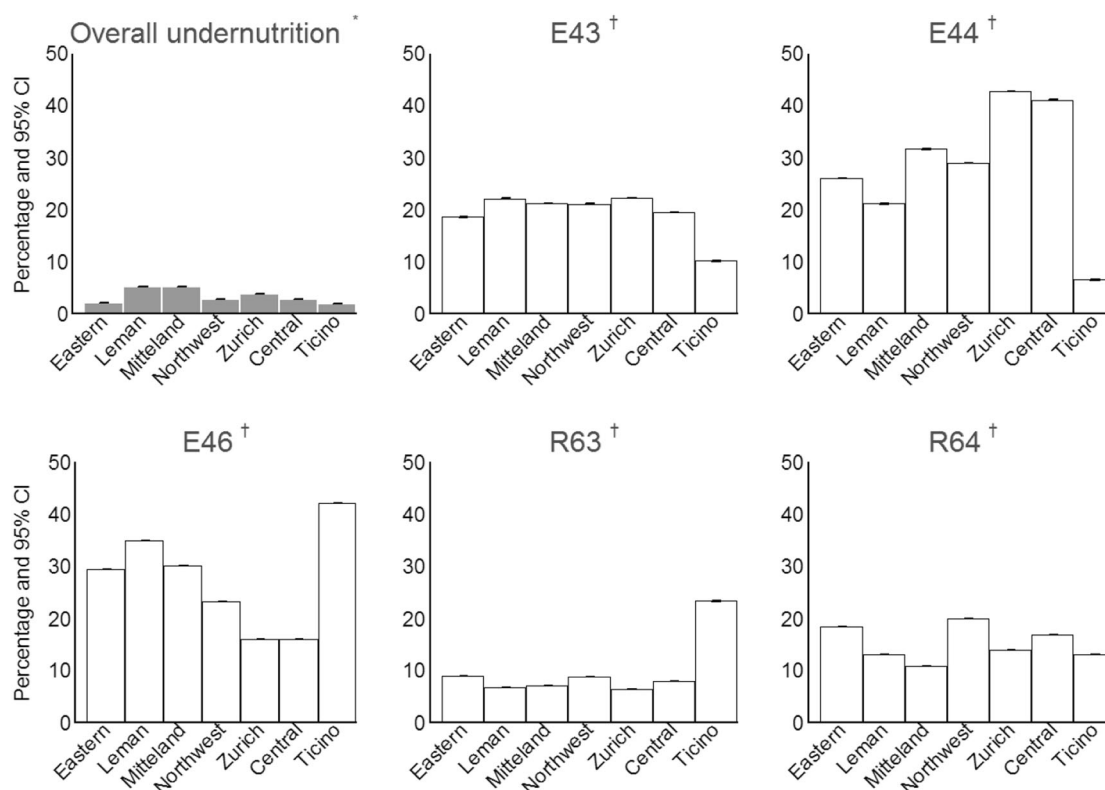


Fig. 1 Prevalence of reported undernutrition, overall, and according to the most frequent undernutrition-related International Classification of Diseases 10th revision codes, by administrative region, Swiss hospital discharge database, 2013–2014. Codes: E43, unspecified severe protein-energy undernutrition; E44, protein-energy malnutrition of moderate and mild degree; E46, unspecified protein-energy malnutrition; R63, includes R63.0 (anorexia), R63.3 (eating difficulties and

mismanagement), R63.4 (abnormal weight loss), and R63.6 (insufficient intake of food and water due to self-neglect); R64, cachexia. * Overall prevalence of reported undernutrition using all hospitalizations ($n = 1,784,855$) as denominator. † Proportion of undernutrition-related ICD-10 codes using hospitalizations with reported undernutrition ($n = 64,243$) as denominator

Prevalence and determinants of reported undernutrition

Of the 1,784,855 hospitalizations, 64,243 (3.6%) had undernutrition reported in their discharge files, the prevalence ranging between 1.8% in Ticino to 4.7% in Mittelland (Fig. 1). The distribution of the most frequent ICD-10 codes for undernutrition (E43, E44, E46, R63, and R64) is shown in Fig. 1. Overall, the use of the different codes greatly differed between regions. Code E43 (unspecified severe protein-energy malnutrition) was seldom used in Ticino, code E44 (protein-energy malnutrition of moderate and mild degree) was mostly used in Zürich and Central Switzerland, code E46 (unspecified protein-energy malnutrition) was mostly used in Ticino and Léman, code R63 (symptoms and signs concerning food and fluid intake) was mostly used in Ticino and code R64 (cachexia) was mostly used in Northwest and Eastern Switzerland.

Results from the multivariable analysis of the factors associated with prevalence of undernutrition (overall and according to the most frequent undernutrition codes) are shown in Table 2. Hospitalizations occurring in 2014, of

patients aged ≥ 65 years, of women, of Swiss nationality, including an ICU stay, having higher CCI, and infectious disease as main cause were more likely to have undernutrition reported. Compared with Eastern Switzerland, all other regions (except Ticino) had a higher likelihood of reporting undernutrition. These results were consistent for ICD-10 codes E43, E44, R63, and R64, while Zürich, Northwest, and Central Switzerland were less likely to report code E46 (Table 2). Sensitivity analysis based on raw data did not change the results (Supplemental Table 4).

Prevalence and determinants of undernutrition management

Of the 64,243 hospitalizations with reported undernutrition, 35,024 (54.5%) reported undernutrition management, the proportions ranging between 28.6% in Ticino and 67.2% in Zürich (Fig. 2). In all regions, the most prevalent nutritional management was a dietitian consultation, followed by enteral nutrition, parenteral nutrition, and multimodal interventions (Fig. 2). Multivariable analysis showed that being hospitalized in 2014, presenting with digestive system,

Table 2 Multivariable analysis of the factors associated with undernutrition prevalence and by different undernutrition codes from the International Classification of Diseases 10th revision, Swiss hospital discharge database, 2013–2014

Characteristics	Undernutrition-related ICD-10 codes					
	Any code (n = 64,243)	E43 (n = 13,726)	E44 (n = 19,234)	E46 (n = 17,915)	R63 (n = 4799)	R64 (n = 8889)
<i>Year</i>						
2013	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
2014	1.31 (1.28, 1.33)	1.12 (1.08, 1.16)	1.43 (1.38, 1.47)	1.90 (1.83, 1.96)	0.97 (0.91, 1.03)	0.77 (0.73, 0.80)
<i>Age group, years</i>						
20–39	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
40–64	1.81 (1.73, 1.89)	1.68 (1.51, 1.87)	1.88 (1.73, 2.05)	2.00 (1.81, 2.20)	1.36 (1.19, 1.55)	2.02 (1.79, 2.29)
Above 65	3.42 (3.27, 3.58)	3.43 (3.09, 3.80)	3.16 (2.90, 3.44)	4.66 (4.23, 5.13)	2.30 (2.02, 2.61)	2.66 (2.34, 3.01)
<i>p-value for trend</i>	0.001	0.001	0.001	0.001	0.001	0.001
<i>Sex</i>						
Man	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Woman	1.24 (1.22, 1.27)	1.24 (1.20, 1.29)	1.22 (1.19, 1.26)	1.21 (1.18, 1.25)	1.15 (1.08, 1.22)	1.35 (1.29, 1.41)
<i>Nationality</i>						
Swiss	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Non-Swiss	0.81 (0.78, 0.83)	0.80 (0.76, 0.85)	0.84 (0.80, 0.88)	0.83 (0.79, 0.87)	0.90 (0.83, 0.99)	0.69 (0.65, 0.75)
<i>Main diagnosis</i>						
Miscellaneous	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Malignant	1.67 (1.63, 1.74)	2.42 (2.28, 2.56)	1.75 (1.67, 1.84)	1.55 (1.47, 1.63)	1.34 (1.21, 1.49)	2.08 (1.94, 2.23)
Circulatory system	0.63 (0.61, 0.65)	0.70 (0.65, 0.75)	0.74 (0.70, 0.79)	0.72 (0.68, 0.76)	0.62 (0.55, 0.70)	0.67 (0.61, 0.73)
Respiratory system	2.07 (2.00, 2.14)	2.70 (2.53, 2.89)	2.17 (2.05, 2.30)	1.61 (1.51, 1.71)	1.15 (1.01, 1.32)	3.85 (3.58, 4.14)
Digestive system	1.90 (1.84, 1.95)	2.80 (2.64, 2.97)	2.27 (2.16, 2.38)	1.74 (1.65, 1.84)	1.33 (1.20, 1.48)	1.65 (1.51, 1.80)
Infectious	2.41 (2.32, 2.51)	3.24 (2.99, 3.51)	2.57 (2.40, 2.76)	2.26 (2.10, 2.43)	1.89 (1.63, 2.18)	2.50 (2.24, 2.79)
Mental and nervous system	1.19 (1.15, 1.23)	1.24 (1.14, 1.34)	1.11 (1.04, 1.19)	1.27 (1.20, 1.36)	1.74 (1.58, 1.92)	1.48 (1.34, 1.62)
<i>Intensive care unit</i>						
No	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Yes	1.96 (1.91, 2.01)	2.56 (2.44, 2.69)	2.14 (2.05, 2.24)	1.66 (1.58, 1.74)	1.23 (1.10, 1.38)	1.28 (1.19, 1.37)
<i>Charlson index</i>						
0–1	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
2+	3.49 (3.41, 3.56)	3.39 (3.23, 3.56)	3.61 (3.47, 3.76)	2.99 (2.87, 3.11)	2.04 (1.88, 2.20)	4.46 (4.20, 4.74)
<i>Region</i>						
Eastern	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Léman	2.24 (2.16, 2.31)	2.51 (2.34, 2.70)	1.74 (1.63, 1.86)	2.59 (2.45, 2.75)	1.69 (1.50, 1.90)	1.45 (1.34, 1.58)
Mittelland	2.31 (2.23, 2.38)	2.52 (2.34, 2.71)	2.72 (2.56, 2.89)	2.26 (2.13, 2.39)	1.86 (1.67, 2.08)	1.24 (1.14, 1.34)



Table 2 (continued)

Characteristics	Undernutrition-related ICD-10 codes					
	Any code (n = 64,243)	E43 (n = 13,726)	E44 (n = 19,234)	E46 (n = 17,915)	R63 (n = 4799)	R64 (n = 8889)
Northwest	1.19 (1.15, 1.23)	1.34 (1.24, 1.45)	1.32 (1.24, 1.42)	0.92 (0.86, 0.99)	1.22 (1.08, 1.38)	1.27 (1.17, 1.38)
Zürich	1.69 (1.63, 1.75)	1.94 (1.80, 2.09)	2.73 (2.56, 2.90)	0.90 (0.84, 0.96)	1.24 (1.10, 1.41)	1.24 (1.14, 1.35)
Central	1.18 (1.13, 1.24)	1.20 (1.09, 1.33)	1.86 (1.72, 2.01)	0.64 (0.57, 0.70)	1.09 (0.93, 1.28)	1.08 (0.97, 1.21)
Ticino	0.74 (0.70, 0.79)	0.40 (0.33, 0.47)	0.18 (0.15, 0.22)	1.07 (0.98, 1.17)	2.18 (1.90, 2.51)	0.52 (0.45, 0.61)

Codes: E43, unspecified severe protein-energy malnutrition; E44, protein-energy malnutrition of moderate and mild degree; E46, unspecified protein-energy malnutrition; R63, includes R63.0 (anorexia), R63.3 (eating difficulties and mismanagement), R63.4 (abnormal weight loss), and R63.6 (insufficient intake of food and water due to self-neglect); R64, cachexia. Data are odd ratio (95% confidence intervals). Multivariable analysis performed using logistic regression adjusting for all variables in the table. Results are weighted based on sex and age categories distribution of the Swiss population for years 2013 and 2014

infectious, or malignancy as main cause for hospitalization, having ICU stay, and having higher CCI were associated with a higher likelihood of receiving any nutritional management (Table 3b). The analysis also showed that reporting of any nutritional management and its different types varied between regions. Compared to Eastern Switzerland, Zürich and Central Switzerland had a higher and Léman, North-west, and Ticino a lower likelihood of reporting any nutritional management. All regions (except Central Switzerland) had lower odds of reporting dietitian consultations than Eastern Switzerland. Zürich, Mittelland and Léman had a higher and Ticino a lower likelihood of reporting enteral nutrition. All regions had higher odds of reporting parenteral nutrition than Eastern Switzerland. Finally, all regions (except Ticino) had a higher likelihood of reporting multimodal management than Eastern Switzerland (Table 3). Sensitivity analysis based on raw data did not change the results (Supplemental Table 5).

Frequency of undernutrition codes allowing reimbursement

Frequencies of undernutrition codes allowing reimbursement of nutrition-related costs by administrative regions are shown in Table 4. Over two-thirds of E43 and E44 codes were considered “reimbursable”, the lowest proportions being found in Ticino and the highest in Central Switzerland or Zürich. When all undernutrition-related codes were considered, only one third was considered “reimbursable”, the lowest proportions being again found in Ticino and the highest in Zürich. More details regarding the associations between undernutrition-related ICD-10 codes and CHOP codes for all of Switzerland are provided in Supplemental Table 6.

Discussion

This is one of the largest, nationally representative studies regarding prevalence of reported undernutrition among hospitalized patients. It is also one of the few assessing management and cost reimbursement of reported undernutrition at the national level. Our results show that prevalence of reported undernutrition, undernutrition coding, nutritional management, and even valuation of undernutrition differ considerably across Swiss administrative regions.

Prevalence and determinants of reported undernutrition

Prevalence of reported undernutrition was 3.6%, a finding in agreement with the only previous study that used

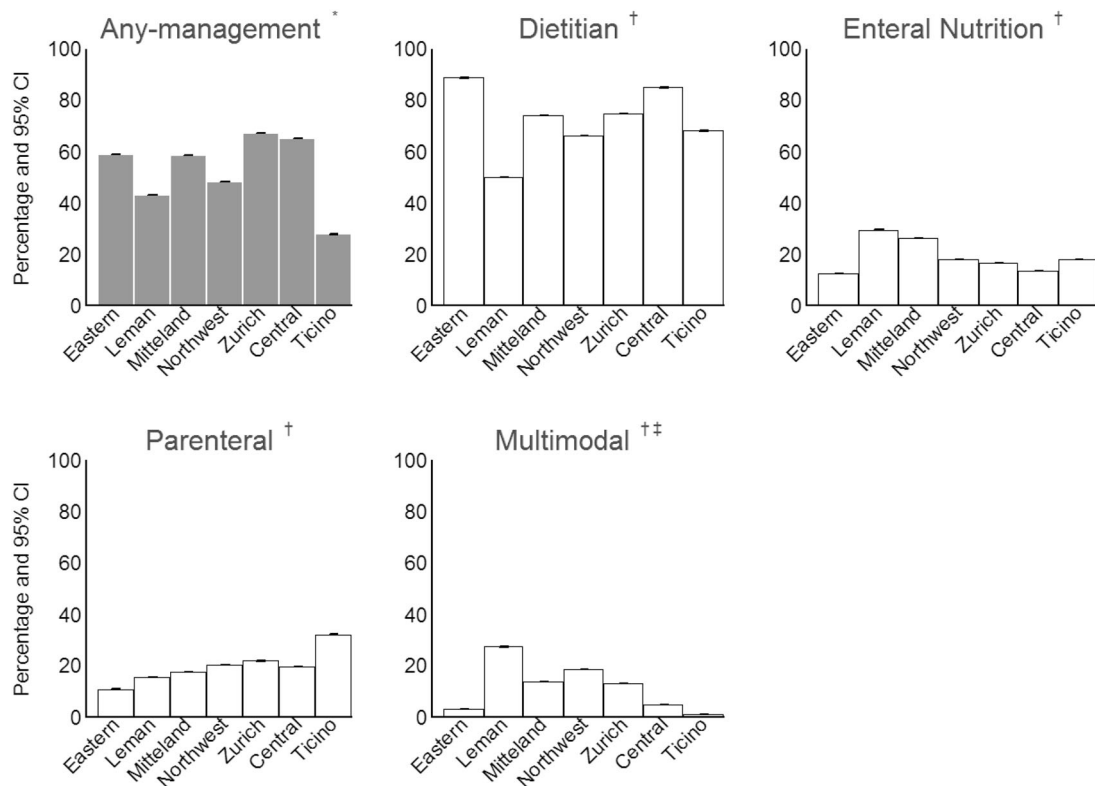


Fig. 2 Prevalence of reported nutritional management among hospitalizations with any International Classification of Diseases 10th revision codes of undernutrition, by administrative region, Swiss hospital discharge database, 2013–2014. *Overall prevalence of reported undernutrition using hospitalizations with any nutrition-related ICD-10 codes ($n = 64,243$) as denominator. †Proportion of different types of nutritional management using hospitalizations with reported nutritional management ($n = 35,024$) as denominator.

‡Multimodal nutritional therapy is coded when management is performed by a specialized team including a specialist doctor, a nurse and a dietician, and includes nutritional evaluation, several meetings to adapt nutritional management, and adequate nutritional documentation in the medical file. Overall percentage of different types of nutritional management is higher than 100% because several patients received multiple managements (i.e., dietician + enteral nutrition)

undernutrition-related ICD-9 codes and that reported a prevalence rate of 3.2% among the United States hospital discharges for 2010 [6]. However, this value is considerably lower than those reported in other studies using different screening tools: between 14 and 32% at national level in Europe [4, 5, 7] and between 13 and 20% in different hospitals in Switzerland [1, 13]. This disparity between reported and objectively assessed prevalence of undernutrition is in line with generally accepted issues regarding undernutrition underestimation, under-recognition and under-reporting in hospital settings [16]. Indeed, a study conducted in England showed that the prevalence of undernutrition using government statistics was <1% of the prevalence obtained in national surveys using the Malnutrition Universal Screening Tool [17]. Interestingly, the prevalence of reported undernutrition was similar in Léman, Mittelland and Zürich regions, possibly due to the presence of highly urbanized cantons like Geneva, Bern, and Zürich, which could lead to a better recognition and detection of health problems by health care professionals [18].

Hospital discharge data can serve several purposes. First, they allow monitoring of the health status of the population and allow planning of health infrastructures to adequately respond to future needs. Second, via the DRG system, they allow reimbursement of hospital costs by the Swiss health system. This duality of purposes can lead to contradictory behaviors, as hospitals might be tempted to favor more “economically interesting” codes, thus biasing the distribution of the diseases. In this study, considerable regional variations were found regarding the use of undernutrition-related ICD-10 codes, even though in January 2014 the Swiss Society of Clinical Nutrition issued recommendations for undernutrition coding [12]. Whether those differences are related to reimbursement issues or to regional disparities in coding procedures remains to be assessed. Overall, our results indicate that in Switzerland, undernutrition is seldom reported in hospital discharge data, and appears to be insufficiently managed. Further, coding procedures vary considerably between regions. Hence, a national or common cantonal policy to ensure proper undernutrition

Table 3 Multivariable analysis of the factors associated with nutritional management among hospitalizations with any International Classification of Diseases 10th revision codes of undernutrition, Swiss hospital discharge database, 2013–2014 ($n = 64,243$)

	Any management ($n = 35,024$)	Different types of nutritional management			
		Dietitian consultation ($n = 24,937$)	Enteral nutrition ($n = 7170$)	Parenteral nutrition ($n = 5870$)	Multimodal intervention* ($n = 5399$)
<i>Year</i>					
2013	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
2014	1.43 (1.39, 1.49)	1.55 (1.50, 1.61)	0.98 (0.93, 1.04)	1.04 (0.97, 1.11)	1.19 (1.12, 1.26)
<i>Age group, years</i>					
20–39	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
40–64	1.04 (0.94, 1.15)	1.01 (0.91, 1.12)	0.86 (0.75, 0.98)	0.75 (0.64, 0.87)	1.20 (1.00, 1.45)
Above 65	0.99 (0.90, 1.08)	1.02 (0.93, 1.13)	0.59 (0.52, 0.68)	0.49 (0.42, 0.56)	1.43 (1.19, 1.72)
<i>p</i> -value for trend	0.77	0.65	<0.001	<0.001	<0.001
<i>Sex</i>					
Man	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Woman	0.97 (0.94, 1.01)	1.02 (0.99, 1.06)	0.73 (0.69, 0.78)	1.10 (1.03, 1.17)	1.01 (0.95, 1.07)
<i>Nationality</i>					
Swiss	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Non-Swiss	0.92 (0.87, 0.97)	0.90 (0.85, 0.95)	1.06 (0.97, 1.15)	1.03 (0.94, 1.14)	0.91 (0.83, 1.00)
<i>Main diagnosis</i>					
Miscellaneous	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Malignant	1.55 (1.47, 1.64)	1.26 (1.19, 1.33)	1.65 (1.51, 1.80)	3.65 (3.29, 4.06)	0.93 (0.85, 1.03)
Circulatory system	0.98 (0.92, 1.04)	0.95 (0.89, 1.01)	1.38 (1.25, 1.53)	0.68 (0.58, 0.79)	1.02 (0.92, 1.13)
Respiratory system	0.97 (0.92, 1.04)	1.03 (0.97, 1.10)	1.11 (1.00, 1.23)	0.50 (0.42, 0.59)	0.89 (0.80, 0.99)
Digestive system	1.80 (1.69, 1.91)	1.40 (1.32, 1.49)	1.42 (1.29, 1.57)	4.34 (3.94, 4.79)	1.16 (1.05, 1.29)
Infectious	1.40 (1.29, 1.51)	1.12 (1.04, 1.21)	1.78 (1.59, 1.98)	1.61 (1.40, 1.85)	1.20 (1.06, 1.36)
Mental and nervous system	0.82 (0.76, 0.88)	0.81 (0.75, 0.88)	1.31 (1.15, 1.48)	0.40 (0.31, 0.51)	1.05 (0.93, 1.18)
<i>Intensive care unit</i>					
No	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Yes	2.99 (2.83, 3.16)	1.43 (1.36, 1.50)	5.17 (4.87, 5.49)	5.79 (5.42, 6.18)	1.01 (0.93, 1.10)
<i>Charlson index</i>					
0–1	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
2+	1.24 (1.20, 1.30)	1.2 (1.15, 1.25)	1.29 (1.2, 1.38)	1.11 (1.02, 1.21)	1.00 (0.93, 1.07)
<i>Region</i>					
Eastern	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Léman	0.54 (0.50, 0.57)	0.26 (0.24, 0.27)	1.85 (1.64, 2.10)	1.21 (1.04, 1.40)	7.35 (6.04, 8.94)
Mittelland	0.97 (0.91, 1.04)	0.70 (0.66, 0.75)	2.14 (1.90, 2.42)	1.74 (1.51, 1.99)	4.76 (3.91, 5.80)
Northwest	0.61 (0.57, 0.66)	0.41 (0.38, 0.44)	1.11 (0.97, 1.27)	1.62 (1.40, 1.88)	5.31 (4.34, 6.50)
Zürich	1.26 (1.17, 1.36)	0.88 (0.82, 0.94)	1.16 (1.02, 1.32)	1.92 (1.67, 2.21)	5.37 (4.39, 6.56)
Central	1.09 (0.99, 1.20)	1.04 (0.95, 1.14)	0.84 (0.71, 1.01)	1.59 (1.34, 1.89)	1.71 (1.30, 2.25)
Ticino	0.28 (0.25, 0.32)	0.23 (0.20, 0.26)	0.74 (0.57, 0.95)	2.12 (1.68, 2.67)	0.17 (0.07, 0.44)

Data are odd ratio (95% confidence intervals). Multivariable analysis performed using logistic regression adjusting for all variables in the table. Results are weighted based on sex and age categories distribution of the Swiss population for years 2013 and 2014

CI confidence interval, OR odd ratio

* Multimodal nutritional therapy is coded when management is performed by a specialized team including a specialist doctor, a nurse and a dietician, and includes nutritional evaluation, several meetings to adapt nutritional management, and adequate nutritional documentation in the medical file

Table 4 Frequency of undernutrition codes allowing reimbursement of nutritionally related costs, by administrative region, Swiss hospital discharge database, 2013–2014

	Switzerland (<i>n</i> = 64,243)	Eastern (<i>n</i> = 5751)	Léman (<i>n</i> = 15,231)	Mittelland (<i>n</i> = 17,320)	Northwest (<i>n</i> = 9233)	Zürich (<i>n</i> = 11,377)	Central (<i>n</i> = 3612)	Ticino (<i>n</i> = 1719)
<i>E43</i>								
All (<i>N</i> total)	13,695	1103	3340	3752	1946	2639	751	164
Reimbursable (%) [*]	65.45	75.81	48.85	70.91	64.39	72.62	78.21	48.05
<i>E44</i>								
All (<i>N</i> total)	19,210	1511	3231	5384	2686	4795	1498	105
Reimbursable (%) [*]	77.37	77.78	65.83	83.45	69.16	81.25	82.01	54.32
All reimbursable (%) [†]	36.86	34.12	24.69	41.26	33.53	50.73	48.81	8.32

Codes: E43, unspecified severe protein-energy malnutrition; E44, protein-energy malnutrition of moderate and mild degree

Results are expressed as number of patients (%)

Results are weighted based on sex and age categories distribution of the Swiss population for years 2013 and 2014

^{*} Based on corresponding codes, [†] Based on all undernutrition-related codes (*n* = 66,243)

detection and management is imperative and should be embedded in routine hospital practice.

Patients aged ≥ 65 years or discharged with a diagnosis of infectious diseases had the highest likelihood of being reported as undernourished. This result is in agreement with the nationally representative studies from the United States [6] and Brazil [19]. Overall, our results suggest that, despite underestimating overall prevalence of undernutrition, hospital discharge data can be used to assess the clinical and individual determinants of undernutrition [20–23].

Prevalence and determinants of undernutrition management

International guidelines recommend that nutritional support be initiated immediately among undernourished patients [24, 25]. Still, only half of hospitalizations with reported undernutrition also included a code related to undernutrition management. This finding is in line with a previous study in one Swiss hospital, where less than half of patients nutritionally ‘at-risk’ received nutritional support [13]. In addition, considerable differences were found between regions. The reasons for such regional heterogeneity in undernutrition reporting could partly be due to the different cantonal health care policies or even to differing hospital guidelines [1, 26]. Moreover, previous studies showed that recommendations regarding undernutrition screening and support are often neglected or not implemented [13, 17, 25, 27].

Dietitian consultation was the most commonly reported nutritional management, a finding in agreement with a previous Swiss study [1]. Dietitian consultation is a first line treatment in malnourished patients, and should be included in any management of malnourished patients.

Frequency of undernutrition codes allowing reimbursement

Undernutrition among hospitalized patients incurs extra hospitalization costs [8, 9, 17], mainly due to increased LOS [4]. In this study, only one third of all undernutrition-related ICD-10 codes and slightly over two-thirds of the E43 and E44 codes were associated with the proper CHOP codes to be considered “reimbursable”. These findings suggest that undernutrition status is undervalued in hospital discharge data, as only a small percentage of all codes will be eligible for reimbursement. Whether this undervaluation is due to inadequate documentation of nutritional management or inadequate coding of undernutrition status remains to be assessed. Further, it should be noted that not all “reimbursable” ICD-10 – CHOP codes associations actually increase reimbursements, as they have to be considered with the other comorbidities for the calculation of the DRG [28]. Again, considerable differences were found between administrative regions, suggesting that coding procedures are differently applied. Noteworthy, the very low proportion of “reimbursable” codes in Ticino might significantly impact hospital reimbursements compared to other regions. It would be of interest to quantify this financial impact and to evaluate the effect of changes in coding procedures in this region. These findings are in agreement with previous literature mentioning that better reporting and coding for undernutrition can have a positive effect on hospital revenues and reimbursement [29]. Proper reimbursement could only be achieved through an interdisciplinary program including early identification, proper treatment and documentation of undernutrition [10, 27, 30].

Strengths and limitations

The strength of this study includes its large and representative sample from 98% of Swiss hospitals and the inclusion of all undernutrition-related ICD-10 codes in the analysis. Nevertheless, several limitations must be acknowledged. First, prevalence was based on ICD-10 codes, and not on objective assessment of undernutrition, hence, prevalence rates were underestimated but in line with similar studies. Second, it was not possible to assess if under-reporting rates were comparable between regions, which could have explained the differences regarding prevalence of undernutrition reporting. As there are no other studies assessing regional differences in undernutrition reporting within a country, it would be imperative that our results be replicated and that under-reporting rates be established for each Swiss region by comparing objectively assessed and reported undernutrition. Finally, in the absence of an international health policy regarding undernutrition recognition, management, and documentation, our results obtained for Switzerland might not be extrapolated to other countries. Still, and as reported above, our results were in agreement with the previous studies from other countries.

Conclusion

In Switzerland, there is considerable regional variation of reporting of undernutrition prevalence, management, and cost reimbursement. Undernutrition appears to be insufficiently managed and valued.

Author contributions S.K.-S and P.M.-V. conceived the paper. S.K.-S. analyzed data and wrote the manuscript. P.M.-V. supervised the analysis, and had primary responsibility for final content. G.W. and C. d.M. reviewed the manuscript and provided critical recommendations. All authors have read and approved the final manuscript.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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