



Original article

Sixteen years trends in reported undernutrition

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SUMMARY

Background & aims: How undernutrition is reported in hospital discharge data is not understood. To assess trends in reported undernutrition and its management among hospitalized patients in Switzerland, and the association between reported undernutrition and in-hospital mortality, acquired infection, intensive care unit stay (ICU), and length of hospital stay (LOS).

Methods: Data from the Swiss hospital discharge databases from 1998 to 2014 ($n = 13,297,188$ hospitalizations, 52.2% women, 48.4% aged 65+, and 85% Swiss national). Reported undernutrition was defined by the presence of any undernutrition-related International Classification of Diseases 10th revision code. Nutritional management was defined by the presence of any nutritional intervention code.

Results: Prevalence of reported undernutrition increased from 0.32% in 1998 to 3.97% in 2014 in Switzerland, and similar but varying trends were found for each of the seven Swiss administrative regions: ranging from 0.18% to 2.13% in Ticino and from 0.23% to 5.63% in Mittelland. Undernutrition management of hospitalizations with reported undernutrition increased from 0.6% in 1998 to 57.8% in 2014, with wide variations according to administrative region: from 0% to 32.9% in Ticino and from 0% to 68.9% in Central Switzerland. After multivariable adjustment, reported undernutrition was positively associated with in-hospital mortality: odds-ratio and (95% confidence interval): 2.30 (2.26–2.34); acquired infection: 3.57 (3.46–3.70); ICU stay: 1.65 (1.63–1.68) and longer LOS: 19.6 ± 0.2 vs. 13.0 ± 0.1 days.

Conclusion: Undernutrition is increasingly reported in Switzerland; still, over 40% of undernourished hospitalizations don't benefit from nutritional support. Reported undernutrition is associated with increased in-hospital mortality, acquired infection, ICU stay, and LOS.

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1. Introduction

Undernutrition is a frequent condition among hospitalized patients [1], leading to increased morbidity, mortality, length of hospital stay, risk of nosocomial infection, and health costs [2–5]. Hospital discharge data is commonly used for disease surveillance and prevention, public health reporting, health services evaluation, and health care costs [6,7]. Hence, adequate reporting of patient's nutritional status in hospital discharge data could provide valuable information regarding the prevalence, health and economic impact

of this condition, and for hospitals, increase reimbursement from third party payers [8]. Still, we have previously shown that nutritional status of hospitalized patients is frequently underreported [9].

Switzerland is a small European country with the second highest and ever increasing per capita health expenditures in the world [10,11]. Hence, information regarding trends in undernutrition is necessary for adequate planning of the resources to manage this condition. To our knowledge, only one study on trends in hospital undernutrition has been conducted in Switzerland, limited to two years (1999 and 2008) and conducted in a single hospital [12]. The results showed no difference in prevalence between the two study periods (69% vs. 70%). Thus, the objectives of this study were to assess a) trends in reported undernutrition; b) trends in undernutrition management among hospitalized patients, and c) the association of reported undernutrition with unfavourable hospital outcomes (e.g. in-hospital mortality and

Abbreviations: CHOP, Swiss classification of surgical interventions; DRG, diagnosis-related groups; ICD-10, International Classification of Diseases 10th revision; ICU, intensive care unit; LOS, length of stay; OR, odds ratio.

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acquired infection) in Switzerland and in each of the seven administrative Swiss regions. We used Swiss hospital discharge databases from 1998 to 2014 to fulfil these aims.

2. Methods

2.1. Databases and available data

Data from the Swiss hospital discharge databases between 1998 and 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. Hospital procedures are coded using the Swiss classification of surgical interventions (CHOP) (16), which also includes non-surgical interventions such as nutritional management.

Eligibility criteria were as follows: adult patients (aged ≥ 20 years); length of hospital stay > 1 day; not having any ICD-10 codes related to pregnancy, childbirth and puerperium (i.e. ICD-10 codes beginning with letter “O”) as main diagnosis, and 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.

2.2. Prevalence and management of undernutrition

Presence of undernutrition was assessed by searching all ICD-10 codes related to nutritional status: E12 (undernutrition-related diabetes mellitus), E40 (kwashiorkor), E41 (nutritional marasmus), E42 (marasmic kwashiorkor), E43 (unspecified severe protein-energy undernutrition), E44 (protein-energy undernutrition of moderate and mild degree), E46 (unspecified protein-energy undernutrition), 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).

As only some ICD-10 codes qualify for reimbursement of hospital expenses, we further grouped them as follows: E43, E44.0, E44.1, E46 and any other code.

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 (89.0A.30, 89.0A.31 or 89.0A.32, depending on year) and multimodal nutritional therapy (89.0A.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 (16).

2.3. Unfavourable hospital outcomes

Overall length of hospital stay (LOS) was indicated in days and length of stay in an intensive care unit (ICU) in hours. When the length of stay in the ICU was zero, it was considered as no stay in ICU. Vital status at discharge was indicated as dead or alive. Acquired hospital infection was defined as the presence of at least one ICD-10 code out of a specific list ([Supplemental Table 1](#)).

2.4. Other covariates

Age was categorized into 4 groups (20–34, 35–49, 50–64, and above 65) and nationality as Swiss/non-Swiss. Main diagnoses for hospitalizations were categorized into seven groups based on the ICD-10 codes ([Supplemental Table 2](#)). The Charlson index was computed from all ICD-10 codes according to an algorithm defined for Switzerland [13].

2.5. Statistical analysis

Statistical analyses were performed using Stata version 14.2 for Windows (Stata corp, College Station, TX, USA). Descriptive analyses were presented as percentage and comparisons were performed using chi-square. Trends were performed for all of Switzerland and stratified by the seven Swiss administrative regions (Leman, Mittelland, Northwest, Zurich, Northeast, Central and South) ([Supplemental Fig. 1](#)). Trends were assessed using logistic regression adjusting for sex, age group, nationality, main diagnostic category, and ICU stay. For Switzerland, a further adjustment on administrative region was performed. Linear and quadratic trends were assessed using the **contrast** post-estimation command. The results were expressed as Odds-ratio (OR) and corresponding 95% confidence intervals.

For the associations between undernutrition reporting and in-hospital acquired infection, death or ICU stay, sensitivity analyses were conducted using the E-value [14]. Briefly, the E-value is defined as the minimum strength of association, on the risk ratio scale, that an unmeasured confounder would need to have with both the treatment and the outcome to fully explain away a specific treatment-outcome association, conditional on the measured covariates. A large E-value implies that considerable unmeasured confounding would be needed to explain away an effect estimate [14]. As the prevalence of the outcomes of interest was $< 15\%$, the relative risk formula was applied. Due to the large sample sizes, statistical significance was considered for a two-sided test at $p < 0.001$.

3. Results

3.1. Characteristics of the hospitalizations

Of the initial 19,574,840 hospitalizations, 6,277,652 (22.1%) were excluded; the reasons for exclusion are presented in [Supplemental Fig. 2](#). The excluded hospitalizations had a higher frequency of women and young hospitalizations, and a lower frequency of Swiss nationals, hospitalizations with ICU stay, and in-hospital mortality ([Supplemental Table 3](#)). The characteristics of the included hospitalizations according to calendar year are summarized in [Table 1](#).

3.2. Trends in reported undernutrition

The number and the percentage of hospitalizations with reported undernutrition, for Switzerland and each Swiss administrative region are summarized in [Fig. 1](#) and [Supplemental Table 4](#), respectively. Those findings were further confirmed by multivariable analysis, which showed a significant increase in the likelihood of reporting undernutrition for Switzerland and all administrative regions ([Fig. 2](#)). Significant linear trends were found for Switzerland and all regions, and significant quadratic trends were also found for Switzerland, Léman, Mittelland, Northwest and Eastern regions.

The distribution of the different undernutrition-related ICD-10 codes, for Switzerland and each Swiss administrative region are presented in [Supplemental Fig. 3](#). An increasing use of E43, E44 and E46 codes at the expense of the other codes was observed.

Table 1
Characteristics of the participants, Swiss hospital discharge data, 1998–2014.

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
N	450,690	572,827	654,104	704,187	749,694	789,291	803,300	813,221	818,655
Women	52.5	52.7	53.2	52.6	52.6	52.3	52.1	52.0	51.9
Age groups									
20–34	14.3	13.0	11.8	10.9	10.6	11.1	10.8	10.2	9.8
35–49	18.8	18.5	17.7	17.8	17.8	18.4	18.6	18.1	17.7
50–64	24.0	24.0	24.4	24.6	24.5	24.5	24.6	24.7	24.8
Above 65	42.9	44.5	46.1	46.7	47.1	46.1	46.0	47.0	47.7
Swiss national	87.9	89.0	90.1	89.0	89.2	85.7	84.3	84.2	83.9
ICU	5.3	4.1	4.8	4.9	4.9	4.9	5.0	4.7	4.2
Year	2007	2008	2009	2010	2011	2012	2013	2014	
N	831,474	845,343	841,808	851,052	870,655	880,269	900,984	919,634	
Women	52.1	52.0	51.9	51.6	51.7	51.5	51.4	51.2	
Age groups									
20–34	9.5	9.4	9.4	9.2	9.2	9.4	9.3	9.3	
35–49	17.1	17.0	16.8	16.6	16.1	15.8	15.6	15.2	
50–64	24.4	24.4	24.2	24.2	23.8	23.9	23.9	23.7	
Above 65	49.0	49.3	49.5	50.0	51.0	50.9	51.3	51.8	
Swiss national	84.0	83.8	83.7	83.5	83.5	83.1	83.0	82.6	
ICU	5.7	5.9	6.2	6.4	6.1	7.2	7.8	7.1	

ICU, intensive care unit. Results are expressed as percentage of the column total. Analyses performed using chi-square; all comparisons have $p < 0.001$.

Conversely, the percentage of the E43, E44 and E46 codes differed between regions; in 2014, E44.1 code represented 7.9% of all codes in Léman and 22.2% in Central Switzerland, while E46 code represented 17.8% of all codes in Central Switzerland and 48.5% in Ticino (Supplemental Fig. 3).

3.3. Trends in reported undernutrition management

The number and the percentage of hospitalizations with reported undernutrition that also included a code for nutritional management for Switzerland and each Swiss administrative region are summarized in Fig. 2 and Supplemental Table 5, respectively. The values increased considerably after 2010, although in 2014 at least one third of all hospitalizations with reported undernutrition still had no nutritional management documented. Those findings were further confirmed by multivariable analysis restricted to the period 2009–2014, which showed a significant increase in the likelihood of managing undernutrition for Switzerland and all administrative regions (Fig. 3).

3.4. Associations with unfavourable hospital outcomes

After multivariable adjustment for sex, age group, nationality, main diagnostic category, year, and administrative region, reported undernutrition was significantly and positively associated with in-hospital mortality, acquired infection, ICU stay, and with a longer LOS, and similar findings were obtained when the analyses were stratified by administrative region (Table 2). Sensitivity analysis showed relatively high E-values for the associations between reported undernutrition and in-hospital death or acquired infection, while the E-values for ICU were lower (Supplemental Table 6).

4. Discussion

Our results indicate that undernutrition status is increasingly being reported in Swiss hospital discharge data. Still, in 2014, 40% of undernourished hospitalizations had no indication of nutritional management. The differences in trends between the seven Swiss administrative regions cannot be explained by differences in patient's characteristics and are likely due to differing or absence of local guidelines regarding undernutrition screening, reporting, and management.

4.1. Trends in reported undernutrition

There is little information regarding trends in undernutrition prevalence among hospitalized patients worldwide [15]. Although valuable initiatives such as the nutrition day [16] or the Fight Against Malnutrition [17] provide important information on nutritional status of hospitalized patients in a wide range of countries and hospital settings, no trends in undernutrition have been derived. A study conducted in Geneva comparing two years (1999 and 2008) showed comparable prevalence of undernutrition (60% and 70%) [12], while a study conducted between 2004 and 2007 in the Netherlands reported a decrease of the condition [15]. Our results showed a steady increase in the number of hospitalizations and in the prevalence of reported undernutrition in the Swiss hospital discharge data, suggesting that diagnosis of undernutrition has improved likely due to medical staff becoming increasingly aware of its importance. Still, in 2014, the prevalence of reported undernutrition was less than 10%, compared to measured rates of over 20% [1] or even 60% [18] in hospital studies. Hence, undernutrition status appears to be considerably underreported in Swiss hospital discharge data, which is in line with our previous findings [9]. Still, this reported prevalence was higher than the 3.2% rate reported in 2010 in the USA [19], suggesting that the under-reporting rate might be even larger in other countries.

An increasing use of E43, E44, and E46 codes at the expense of the undernutrition-related ICD-10 codes was observed. Our results also show that coding of certain conditions is dependent on their reimbursement; for instance, as only the E43, E44 and E46 codes qualify as reimbursable by the Swiss Diagnosis-related groups (DRG), they progressively replaced the other undernutrition-related codes in the hospital statistics. Interestingly, the E43 code was the most frequent in Central Switzerland compared to the E46 code in Ticino. A possible reason for such differences might be different coding recommendations according to administrative regions, but this issue remains to be assessed. These coding recommendations might have significant economic impact in the future; for instance, starting in January 2017, the E46 code will no longer be considered for reimbursement by the Swiss DRG system. Hence, unless the coding procedure changes considerably in Ticino, a significant part of all undernutrition-related codes will no longer be considered for reimbursement, with possible economic consequences. Overall, our results stress the need to strengthen common

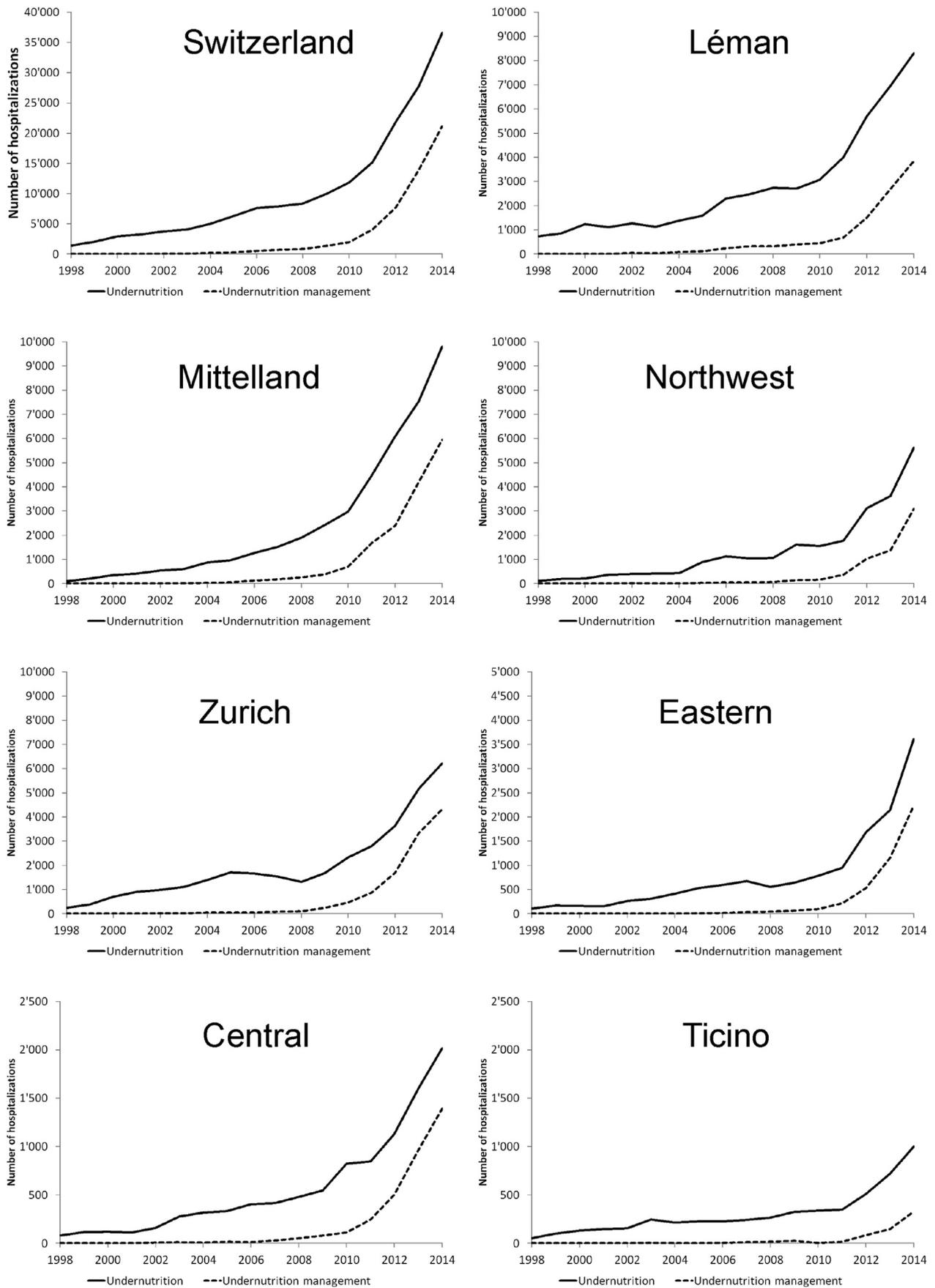


Fig. 1. Number of hospitalizations with reported undernutrition (full lines) and undernutrition management (dotted lines), for Switzerland and the seven Swiss administrative regions, Swiss hospital discharge data, 1998–2014.

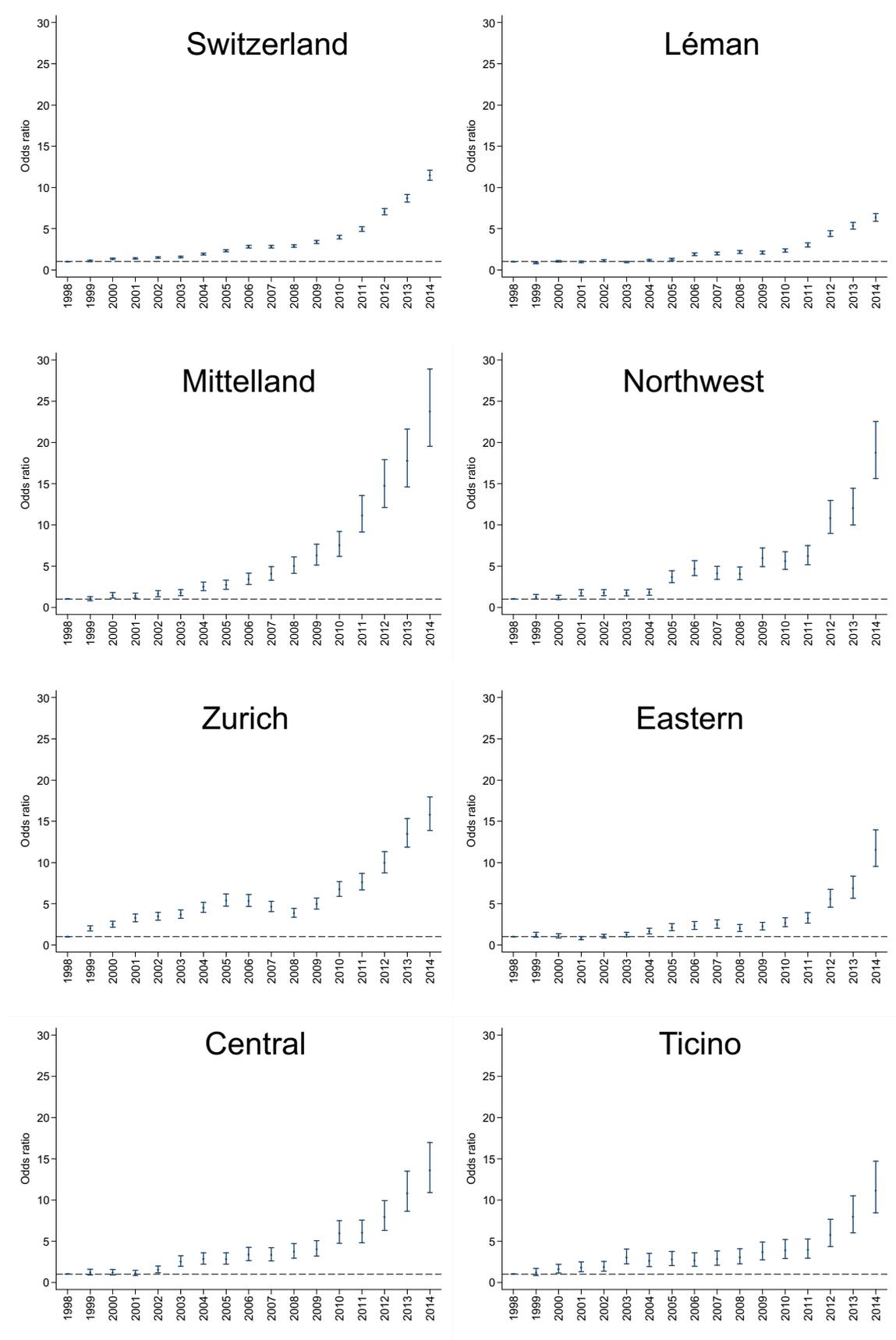


Fig. 2. Trends in hospitalizations with reported undernutrition, for Switzerland and the seven Swiss administrative regions, Swiss hospital discharge data, 1998–2014. Results are expressed as multivariate adjusted odds ratio and 95% confidence interval. Significant linear trends were found for Switzerland and all regions, and significant quadratic trends were also found for Switzerland, Léman, Mittelland, Northwest and Eastern regions.

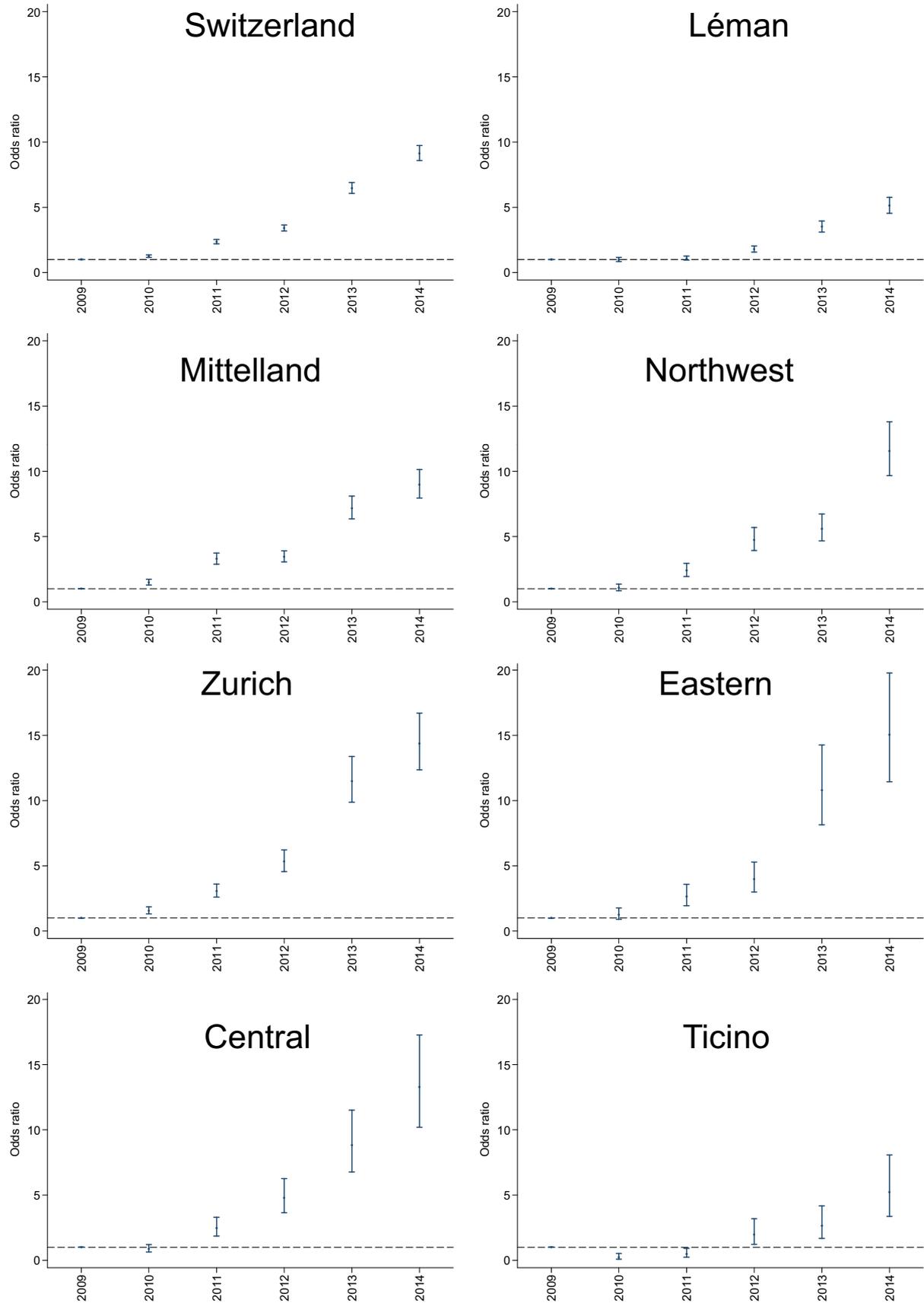


Fig. 3. Trends in hospitalizations with reported undernutrition and undernutrition management, for Switzerland and the seven Swiss administrative regions, Swiss hospital discharge data, 2009–2014. Results are expressed as multivariate adjusted odds ratio and 95% confidence interval. Due to the small number of cases before 2009, only the period 2009–2014 is shown. Significant linear trends were found for Switzerland and all regions, and significant quadratic trends were also found for Switzerland and Ticino.

Table 2

Association of reported undernutrition with unfavourable hospital outcomes, for Switzerland and each Swiss administrative region, Swiss hospital discharge data, 1998–2014.

	In-hospital death	Intensive care unit	Acquired infection	Length of stay	
				Not reported	Reported
Overall Switzerland	2.30 (2.26–2.34)	1.65 (1.63–1.68)	3.57 (3.46–3.70)	13.0 ± 0.1	19.6 ± 0.2
Swiss Administrative regions					
Léman	2.35 (2.27–2.44)	1.28 (1.24–1.32)	3.32 (3.09–3.56)	13.2 ± 0.1	25.0 ± 0.2
Mittelland	2.21 (2.12–2.29)	2.35 (2.28–2.42)	4.16 (3.91–4.42)	13.1 ± 0.1	17.9 ± 0.6
Northwest	2.17 (2.06–2.28)	1.37 (1.31–1.44)	3.37 (3.06–3.70)	13.1 ± 0.1	18.6 ± 0.5
Zurich	2.44 (2.34–2.54)	1.91 (1.84–1.97)	3.86 (3.58–4.15)	12.3 ± 0.1	16.7 ± 0.5
Eastern	2.15 (2.01–2.31)	1.32 (1.24–1.42)	3.35 (2.97–3.78)	14.2 ± 0.1	18.5 ± 1.3
Central	2.36 (2.18–2.55)	1.83 (1.73–1.94)	3.32 (2.87–3.85)	12.3 ± 0.1	15.1 ± 1.2 ¹
Ticino	3.22 (2.91–3.57)	1.04 (0.93–1.16) ²	2.64 (2.05–3.39)	12.3 ± 0.1	16.7 ± 0.3

Results are expressed as multivariable-adjusted odds ratio and (95% confidence interval) for reported undernutrition relative to no reporting, or as multivariate-adjusted average ± standard error. For in-hospital death, intensive care unit and acquired infection, analyses were performed using logistic regression adjusting for sex, age groups, nationality, main diagnostic category, Charlson index and year. For length of stay, analyses were performed on log-transformed data adjusting for sex, age groups, nationality, main diagnostic category, intensive care unit, in-hospital death and year. For Switzerland, a further adjustment on administrative region was performed. All results are $p < 0.001$, except ¹ ($p < 0.05$) and ² not significant.

reporting and coding of undernutrition status, as suggested by the Swiss Society of Dietitians [20,21]. Our results also indicate that focussing on specific undernutrition-related ICD-10 codes might lead to biased results, as the choice of the codes is not solely dependent on the patient's status but also on the reimbursement potential of the code.

4.2. Trends in reported undernutrition management

In 2011, two new CHOP codes regarding nutritional management (89.OA.30 for dietary advice and 89.OA.31 for nutritional therapy) were introduced in the Swiss CHOP system [20]. The codes were further grouped into a single code, nutritional advice and therapy (89.OA.32) in 2012. This introduction led to a considerable increase in the number of reported undernutrition management, as the previous codes were only related to enteral and parenteral nutrition. Notwithstanding, in 2014, only 60% of hospitalized patients with reported undernutrition had an indication of nutritional management. Nevertheless, it should be noted that this value is considerably higher than in a previous Swiss study [18] or a study conducted in six other European countries, where prevalence of clinical nutrition support ranged between 19.9% in Greece to 39.0% in Estonia [17].

Considerable differences in nutritional management were found according to the administrative regions, and those differences persisted after multivariable adjustment for possible confounders. Overall, our results suggest that undernutrition is managed differently according to administrative region, but the reasons for such differences remain to be assessed. It remains a necessity to have a common guideline regarding undernutrition management in Switzerland, so that undernourished patients can benefit from the same quality of care irrespective of the hospital they attend.

4.3. Associations with unfavourable hospital outcomes

Reported undernutrition was associated with an increased likelihood of in-hospital mortality, in-hospital acquired infection, ICU stay and LOS. Furthermore, sensitivity analysis showed relatively high E-values for the associations between reported undernutrition and in-hospital death and acquired infection, suggesting that these associations are unlikely due to unmeasured confounders. Conversely, the E-values for ICU were lower, suggesting that the observed associations could be ruled out by an unmeasured confounder associated with both the undernutrition and the ICU with a minimal OR ranging between 1.79 and 3.99 [14]. Nevertheless, these findings confirm the previous literature [2,3,19]

indicating that undernutrition is a serious condition carrying a significant burden for in-patients, the health care team and the community, as increased LOS leads to increased health care costs.

4.4. Study strengths and limitations

The strength of this study relies on its long time period and on its large sampling rate, covering almost all Swiss hospitals (98%). The results can thus reliably be considered as representative of all Swiss hospitalizations for the period between 1998 and 2014.

This study has also several limitations. Firstly, prevalence of undernutrition was based on ICD-10 codes, and not on objective assessment of undernutrition; consequently, and as indicated previously, prevalence rates are underestimated but nevertheless higher than in similar studies [19]. Secondly, it was not possible to distinguish if the observed increase in the prevalence of reported undernutrition is due to a real increase in this condition or to a higher awareness regarding this condition by the health care professionals. Still, our results indicate that undernutrition is an increasing concern among hospitalized patients and that it should be increasingly considered for future public health care policies. Thirdly, due to legal constraints and to the lack of a unique identifier, only hospitalizations could be analysed, not individual patients. Therefore, it is likely that undernourished patients with multiple hospitalizations might have artificially increased the prevalence of undernutrition. Finally, and as for undernutrition, prevalence of undernutrition management was based on CHOP codes, not on an objective evaluation of the nutritional therapies provided to the patients; whether nutritional therapies are under or over reported in Swiss hospital discharge data has not yet been assessed.

5. Conclusion

Undernutrition status is increasingly reported in Swiss hospital discharge data. Still, in 2014, over 40% of undernourished hospitalizations had no indication of nutritional management. Reported undernutrition is associated with increased in-hospital mortality, acquired infection, ICU stay, and LOS. Trends differ considerably between Swiss administrative regions and are independent of the hospitalization's characteristics.

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Conflict of interest

There is no conflict of interest to declare.

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SKS and PMV conceived the paper. SKS analyzed data and wrote the manuscript. CdM revised the manuscript for important intellectual content. PMV supervised the analysis, and had primary responsibility for final content. All authors have read and approved the final manuscript.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.clnu.2018.01.021>.

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