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ORIGINAL ARTICLE

Profile and prevalence of malnutrition in children with spinal cord injuries—assessment of the Screening Tool for Assessment of Malnutrition in Paediatrics (STAMP)

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Background: Data on the prevalence of malnutrition in paediatric patients with spinal cord injury (SCI) are limited. The present study aimed to establish the risk of (i) under-nutrition by using the Screening Tool for Assessment of Malnutrition in Paediatrics: STAMP (score $\geqslant 2$) and (ii) over-nutrition by body mass index (BMI) centile ($\geqslant$91st: overweight; $\geqslant$98th: obese).

Methods: After obtaining informed consent, a standardized questionnaire was used to collect baseline demographic data and nutrition risk score; BMI was measured and routine blood biochemistry was reviewed in every child (>6 months and <18 years) admitted to the SCI centre.

Results: Sixty-two children (mean age, 11.4 years; s.d., 4.9; median, 13 years; interquartile range, 7.8–15.6, 39.4% female) with SCI (46.5% tetraplegia, 53.4% complete SCI) were assessed. Prevalence of over-nutrition was high (BMI centile $\geqslant$91st, 41.1%; $\geqslant$98th, 25.5%). Under-nutrition risk was 47.1% (STAMP $\geqslant 2$). Only 60% of these 'at risk' patients were referred for further nutritional assessment. Associated phenomena included previous intensive care (55.6 versus 20.8%, $P<0.05$), mechanical ventilation (58.3 versus 18.2%, $P<0.01$) and past need for artificial nutrition support (75 versus 12.8%, $P<0.01$).

Conclusions: Both over- and under-nutrition appear common in children with SCI. Our data indicate, furthermore, that children at nutritional risk are under-managed. Future research is needed to complete the validation of the screening tools and to determine how effective intervention can be ensured.

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INTRODUCTION

Malnutrition, including both under- and over-nutrition, is associated with poor clinical outcomes, including increased mortality.[1–6] It provokes a higher risk of nosocomial infections,[3] delayed wound-healing,[4] reduced gut function,[6] longer dependence on mechanical ventilation and longer hospital stays.[2,6] In addition, in children malnutrition is associated with poorer somatic growth and development, and reduced or delayed mental and psychomotor development.[2,7,8] There is a relationship between impaired growth status and poor school performance, and with reduced intellectual achievement.[7] Faltering growth in early childhood is also associated with significant functional impairment and reduced work capacity, thus affecting later economic productivity.[7]

The mechanisms for malnutrition in children with spinal cord injury (SCI) probably include reduced nutritional intake owing to feeding difficulties, such as lying flat or mechanical or neurological dysphagia,[9,10] and increased nutritional requirements owing to the presence of co-morbidity such as the extra calorie demand in those with repeated chest infections or other catabolic states.[11] This is incompletely balanced by reductions in nutritional needs (especially in those with complete high tetraplegia) as the inability to use major muscle groups results in reduced muscle metabolism.[12]

Generic national[2,5,6] and international guidelines[8] have highlighted the importance of nutrition screening as the first step in fighting childhood malnutrition. However, whereas monitoring growth by plotting the appropriate growth charts[8] is regarded as a standard of routine practice in paediatrics, nutrition screening has received less attention in both clinical and public health arenas.[13]

Researchers have taken different approaches to tackle childhood malnutrition, including delineation of the problem by developing paediatric nutritional risk-screening tools. Good examples include the 'Paediatric Nutritional Risk Score'[14] and the 'Subjective Global Nutritional Assessment tool'.[15] However, both of these tools have been found to be relatively complicated and time-consuming for ready use in screening. Hulst *et al.*[16] developed the $\text{STRONG}_{\text{kids}}$ tool, but this is designed for use by paediatricians, which may therefore render it less suitable for use by nurses and other healthcare professionals. More recently, the Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP)[17] was developed in the United Kingdom specifically for use by members of the multi-disciplinary team, but to date there are very limited data available on its use in practice.

In response to the national guidance,[2,5,6] the STAMP was selected to screen all paediatric patients admitted to the National Spinal Injuries Centre at Stoke Mandeville Hospital as from December 2009. The practical consequences of this policy have not been addressed

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previously. A prospective study was commenced with the aims of describing the nutritional profile of children admitted to the SCI centre, and reporting on the prevalence of risk of under-nutrition and over-nutrition.

METHODS

Subject recruitment

Every child admitted to the National Spinal Injuries Centre between January 2010 and December 2010 was invited to participate in the study. The inclusion criteria were age between 6 months and 18 years, presence of SCI and an expected in-patient stay of at least 1 day. Day care patients and those who were treated exclusively in the intensive care unit were excluded.

Data collection

As part of the National Spinal Injuries Centre admission process, it is expected that STAMP score and body mass index (BMI) centile are routinely obtained by the nurses, using standardized equipment (calibrated digital scales and anthropometer).

A post-admission dietetic assessment using all available clinical, nutritional and biochemical information was performed by the researcher. This included baseline demographics and clinical characteristics of patients (including age, gender, level of SCI, American Spinal Injury Association Impairment Scale (AIS) and reason for SCI). Nutrition-related factors such as route of nutrition, nutrient intake estimated by food record charts, interruptions and supplementation of nutrition were recorded. In addition, clinical data, including presence of co-morbidities, use of mechanical ventilation, history of intensive care and the current number of medications, were recorded. Results of routine blood tests, including urea and electrolytes, total protein and albumin concentration, haemoglobin and C-reactive protein, were recorded where these had been performed.

A senior clinical adviser (AG) was available throughout the study period for questions arising from the participants or their family.

Definition of malnutrition

The risk of under-nutrition was determined from the STAMP score. The STAMP assesses three elements, clinical diagnosis, nutritional intake and anthropometric measures. Each element was scored and children with an overall score of 2 or more were considered at nutritional risk. Additional results from the dietetic assessment were collected for comparison.

Over-nutrition was determined from the BMI centile. Patients with BMI centiles $\geqslant$91st were considered as overweight and those $\geqslant$98th centile as obese.[5]

Ethical consideration

This study received ethical approval from the National Research Ethics Committee (09/H0604/132). Written informed consent from parents (with oral agreement from the children themselves whenever possible) was obtained prior to data collection.

Statistical analysis

Comparisons were made according to the risk of under-nutrition (low-risk and at-risk group). χ^2-Tests were used to compare percentage difference between groups. Continuous data between the groups were compared by Student's *t*-test or Mann–Whitney *U*-test depending on the distribution of data, with statistical significance set at the 5% level ($P<0.05$). All statistical tests were conducted using the Minitab Statistical Software (version 15.0; Minitab Inc., Coventry, UK).

RESULTS

Sixty-two patients (aged 1–18 years (median, 13 years; interquartile range, 7.8–15.6), 39.4% female and 83.6% Caucasian) were assessed.

Twenty-seven patients (46.5%) were tetraplegic (13 were complete tetraplegic, AIS: A) and 31 were paraplegic (18 were complete paraplegic, AIS: A).

Twelve children (19.2%) were on their first admission. The median duration of SCI was 4 years, with an interquartile range of 2.0–8.3 years.

There were no statistical differences between the genders on anthropometric, biochemical or nutritional indices, apart from a higher concentration of serum creatinine in the boys (50 versus 43 $\mu mol\,l^{-1}$, $P<0.05$).

Prevalence and profile of under-nutrition

Of the 62 children, 51 had been screened on admission using STAMP (82.3%) (weight/height was not obtained in 11 patients). At this time, 47.1% (24/51) were found to be nutritionally at risk (STAMP score $\geqslant$2) and 23.5% (12/51) were at 'high risk' (STAMP score $\geqslant$4).

When comparing the well-nourished and undernourished patients (identified by STAMP screening), patients at risk of under-nutrition were found to receive more medications (5 versus 3, P=0.048). (Table 1) No statistically significant differences were found in other indices, but undernourished patients with paraplegia were found to have a lower height centile than well-nourished patients with paraplegia (second centile versus fiftieth centile, $P<0.05$) (Table 2).

Of the 51 screened patients, 15 (29.4%) were deemed to be at risk of under-nutrition after assessment by dietitian.

When comparing the well-nourished and undernourished patients as identified by the dietitian's assessments, the undernourished patients were found to have statistically significant lower BMIs (18.7 versus 14.7 $kg\,m^{-2}$; P=0.034) and BMI centiles (50th versus 5.5th, P=0.041), less appetite (percentage of meals eaten, 100 versus 75%, P=0.01), higher C-reactive protein ($mg\,l^{-1}$, 1 versus 23, P=0.029) and received more prescribed medications (4 versus 7, P=0.017) (Tables 2 and 3).

Undernourished patients were more likely to have experienced previous intensive care (STAMP, 66.7 versus 56.3% (non-significant); dietitian assessment, 55.6 versus 20.8%, $P<0.05$), mechanical ventilation (STAMP, 75 versus 54.5% (non-significant); dietitian assessment, 58.3 versus 18.2%, $P<0.01$) and to have had a past need for artificial nutritional support (STAMP, 87.5 versus 17%, $P<0.01$; dietitian assessment, 75 versus 12.8%, $P<0.01$) (Table 4). Malnutrition risk was commoner in new admissions than in those with chronic SCI (readmissions) (50 versus 16%, P=0.034).

Prevalence of over-nutrition

Of the 51 patients who could be screened, 21 (41.2%) patients (9 were tetraplegic and 12 were paraplegia) were found to be overweight ($\geqslant$91st BMI centile); 13 (25.5%) (4 were tetraplegic and 9 were paraplegic) were obese ($\geqslant$98th BMI centile); and 5 (9.8%) (1 was tetraplegic and 4 were paraplegic) were morbidly obese ($>$99.6th centile).

Over-nutrition was significantly more common in chronic SCI than in new admissions (40 versus 8.3%, P=0.011).

DISCUSSION

Recent literature has highlighted childhood malnutrition as an important clinical and public health problem, which is under-detected and under-managed.[2,12–14,17,18] Across Europe, the documented prevalence of malnutrition in hospitalized children ranges from 15 to 30% depending on the criteria used and the countries involved.[18] We present here data that confirm that both under-nutrition and over-nutrition are common in paediatric SCI patients in the United Kingdom, supporting the prior more limited observations to this effect. Our data suggest a disproportionate risk of under-nutrition when compared with the general in-patient paediatric population,[19] and the prevalence of children with SCI and obesity also appears above national estimates (25.5 versus 20%).[20]

Table 1 Comparison of clinical and nutritional indices with STAMP

	Not at risk (STAMP score ⩽1)				*At risk (STAMP score ⩾2)*				*Overall*
	Overall	*Tetra*	*Para*	P-*value*	*Overall*	*Tetra*	*Para*	P-*value*	P-*value*
Appetite (% eaten)	100	100	100	0.789	100	75	100	0.112	0.204
No. of drugs	3	3.5	2	0.471	5	6	4	0.029	0.048[a]
T. protein ($g\,l^{-1}$)	68	66	73	0.014	73	73	72.5	0.373	0.127
Albumin ($g\,l^{-1}$)	38	38	39	0.286	38	37	39	0.572	0.903
CRP ($mg\,l^{-1}$)	1	1	1	1.0	3.5	4	1	0.377	0.065
Hb ($g\,l^{-1}$)	12.4	12.4	12.9	0.831	12.7	12.5	12.7	0.901	0.481
WCC ($\times 10^9\,l^{-1}$)	6.6	6.5	6.1	0.753	7.3	8.2	7.2	0.73	0.104
Mg ($mmol\,l^{-1}$)	0.89	—	—	—	0.97	1	0.95	0.391	0.650
Ca ($mmol\,l^{-1}$)	2.4	2.43	2.39	0.847	2.4	2.4	2.4	0.789	0.672
Na ($mmol\,l^{-1}$)	140.5	140.5	140.5	1.0	139.5	139	140.5	0.668	0.714
K ($mmol\,l^{-1}$)	4.2	4.2	4.2	0.831	4.25	4.2	4.3	0.767	0.714
Urea ($mmol\,l^{-1}$)	3.9	3.7	3.9	0.594	4.1	4.2	4.0	0.575	0.452
Creatinine ($\mu mmol\,l^{-1}$)	44.5	45.5	41.5	0.337	44	43.7	47	0.843	0.935

Abbreviations: appetite, % of meal eaten; BMI, body mass index; CRP, C-reactive protein; Hb, haemoglobin; Ca, corrected calcium; Para, paraplegic; STAMP, Screening Tool for the Assessment of Malnutrition in Paediatrics); Tetra, tetraplegic; T. protein, total protein level; WCC, white cell count.
[a]$P<0.05$: Overall, mean values between group: well versus at risk of under-nutrition.

Table 2 Comparison of anthropometric indices with RD assessment

	Not at risk (RD assessment: low risk)				*At risk (RD assessment: at risk)*				*Overall*
	Overall	*Tetra*	*Para*	P-*value*	*Overall*	*Tetra*	*Para*	P-*value*	P-*value*
Age (years)	11.7	13.0	11.7	0.758	12.0	15.0	12.0	0.772	0.749
Height (m)	1.37	1.43	1.34	0.239	1.41	1.25	1.41	0.936	1.0
Height centile	9	9	17	1.0	50	50	29.5	0.284	0.380
Weight centile	25	50	25	0.289	9	29.5	0.4	0.064	0.259
BMI ($kg\,m^{-2}$)	18.7	18.9	16.9	0.075	14.7	16.8	13.3	0.200	0.034[a]
BMI centile	50	50	25	0.049	5.5	37.5	1.2	0.378	0.041[a]
Wt for Ht centile	97.5	110.5	94.5	0.008	90.9	99	77.4	0.128	0.101
Ht for age centile	95	94.6	95.5	0.874	98.3	100.3	95.5	0.229	0.710

Abbreviations: Ht for age, height for age; Para, paraplegic; RD, dietitian; Tetra, tetraplegic; Wt for Ht, weight for height.
[a]$P<0.05$: Between group (overall): well versus at risk of under-nutrition.

Table 3 Comparison of clinical and nutritional indices with RD assessment

	Not at risk (RD assessment: not at risk)				*At risk (RD assessment: at risk)*				*Overall*
	Overall	*Tetra*	*Para*	P-*value*	*Overall*	*Tetra*	*Para*	P-*value*	P-*value*
Appetite (% eaten)	100	100[†]	100	0.744	75	50[†]	100	0.160	0.010[†]
No. of drugs	4	3[†]	4	0.145	7	9.5[†]	6.0	0.082	0.017*
T. protein ($g\,l^{-1}$)	70	65	75	0.003	69	68	72.5	0.270	0.946
Albumin ($g\,l^{-1}$)	38	38	39	0.063	38	36	40.5	0.178	0.423
CRP ($mg\,l^{-1}$)	1	1	1	0.648	23	42	23	0.728	0.029
Hb ($g\,l^{-1}$)	12.6	12.4	12.7	0.523	12.4	12.4	11.8	0.540	1.0
WCC ($\times 10^9\,l^{-1}$)	6.7	6.7*	6.7	1.0	10.0	10.0*	8.8	0.713	0.019
Mg ($mmol\,l^{-1}$)	0.96	0.97	0.95	1.0	0.89	0.96	0.87	0.723	0.640
Ca ($mmol\,l^{-1}$)	2.4	2.43	2.39	1.0	2.41	2.38	2.43	0.596	0.751
Na ($mmol\,l^{-1}$)	140	140.5	140	1.0	130	139	139	0.713	0.640
K ($mmol\,l^{-1}$)	4.2	4.2	4.3	0.886	4.3	4.3	4.2	0.806	0.689
Urea ($mmol\,l^{-1}$)	4.1	4.1	4.1	1.0	4.4	4.4	3.7	0.624	0.689
Creatinine ($\mu mmol\,l^{-1}$)	45	45.5	44	0.721	50	57	40.5	0.037	0.463

Abbreviations: appetite, % of meal eaten; BMI, body mass index; CRP, C-reactive protein; Hb, haemoglobin; Ca, corrected calcium; Para, paraplegic; RD, dietitian; T. Protein, total protein level; Tetra, tetraplegic; WCC, white cell count.
*$P<0.05$: Between group: well versus at risk of under-nutrition.
†$P<0.01$: Between group: well versus at risk of under-nutrition.

Table 4 Nutrition risk according to patient's sociodemographic data and severity of SCI

Number		*At risk (%)*	
		STAMP⩾2	*RD (yes)*
Admission type (n=62)			
New admission	12 (19.4%)	6 (50%)*	4 (33.3%)
Re-admission	50 (80.6%)	8 (16%)*	11 (22.0%)
Gender (n=61)			
Boy	37 (60.6%)	21 (56.8%)[a]	10 (27.0%)[a]
Girl	24 (39.4%)	13 (54.2%)[b]	5 (20.8%)[b]
Cause of injury (n=61)			
RTA	21 (34.4%)	9 (42.8%)[b]	3 (14.3%)[b]
Domestic	1 (1.6%)	—	—
Sport	5 (8.2%)	3 (60.0%)	2 (40.0%)
Assault	1 (1.6%)	1 (100%)	1 (100%)
Non-traumatic	33 (54.1%)	19 (57.6%)[b]	9 (27.3%)[b]
Social history (n=61)			
Alcohol user	5 (8.2%)	3 (60.0%)	3 (60.0%)
Ethnicity (n=61)			
Caucasian	51 (83.6%)	26 (50.9%)[b]	14 (27.5%)[b]
Asian	8 (13.1%)	7 (87.5%)[a]	1 (12.5%)[a]
Afro-Caribbean	2 (3.3%)	0	0
Disease severity			
Ventilated	12 (21.4%)	9 (75.0%)	7 (58.3%)†
Non-ventilated	44 (78.6%)	24 (54.5%)[a]	8 (18.2%)†,[a]
Hx ICU stay	9 (15.8%)	6 (66.7%)	5 (55.6%)*
No ICU stay	48 (84.2%)	27 (56.3%)	10 (20.8%)*
Pressure ulcers	6 (10.9%)	2 (33.3%)	3 (50.0%)
No pressure ulcers	47 (89.1%)	30 (63.8%)	11 (23.4%)
Artificial nutrition support	8 (14.5%)	7 (87.5%)†	6 (75.0%)†
Non-artificial nutrition support	47 (85.5%)	8 (17.0%)†,[b]	6 (12.8%)†,[b]

Abbreviation: RTA, road traffic accident.
Statistically significant between group: admission type; gender; disease severity (*$P<0.05$, χ^2; †$P<0.01$, χ^2).
[a]Statistically significant between group (STAMP versus RD assessment, $P<0.01$, χ^2).
[b]Statistically significant between group (STAMP versus RD assessment, $P<0.05$, χ^2).

The observed difference in the prevalence of malnutrition risks between new patients and those with chronic SCI has several possible explanations. The nutritional needs of patients who have recently sustained an SCI and are still recovering from the acute trauma are self-evidently different from those in patients who are stable and undergoing rehabilitation. Weight loss is common during the acute and early rehabilitation phase of SCI. In addition, ventilatory support and tracheostomy may present physical barriers to eating and drinking, which may persist after their withdrawal. Studies have reported that 16% of patients have dysphagia after SCI.[9,10] In the longer term, there is a tendency for a person with an SCI to gain weight. Prolonged inactivity after SCI can cause a shift in body composition and muscle atrophy; lack of education and/or awareness of nutritional needs after SCI may also contribute to positive energy balance and obesity.[12] It is possible also that we have seen a higher than average frequency of nutritional problems through referral bias given that the study was conducted at the national centre for spinal injuries, which will accordingly see more patients with complications of SCI, which most probably themselves increase nutritional risk.

It is a frequent finding that many in-patients at risk of, and actually suffering from, malnutrition do not receive appropriate nutrition while hospitalized (typically in excess of 50%).[18] In the present study, a small majority (57.1%) of high-risk patients were referred for nutritional assessment and nutritional intervention. As it is likely that the overt research interest of the local investigators will have had a positive effect on referral practice, these findings suggest that malnutrition is generally still under-recognized and unmanaged to a worrying extent in SCI patients.

Both over- and under-nutrition appear common in children with SCI. Associated phenomena include previous intensive care, mechanical ventilation and past need for artificial nutrition support, and these could be markers for continuing under-nutrition. SCI children at nutritional risk are under-managed. Future effort is needed to implement the use of nutrition screening tools in SCI centres and to ensure that appropriate care plans are in place to treat at-risk individuals.

CONFLICT OF INTEREST

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Author contributions: SW: Protocol development, data collection, data analysis and manuscript preparation. AG: Protocol development, clinical supervision and manuscript revision. SH: Statistical supervision and manuscript revision. GG: Academic supervision and manuscript revision. AF: Academic supervision and manuscript revision.

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