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Sarcopenic obesity in patients with head and neck cancer is predictive of critical weight loss during radiotherapy

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Abstract

The impact of computed tomography-defined sarcopenia on outcomes in head and neck cancer has been well described. Sarcopenic obesity (SO) (depleted muscle mass combined with obesity) may pose a more serious risk than either condition alone. We investigated SO and its impact on survival and critical weight loss (≥ 5 %) in patients with head and neck cancer who received curative radiotherapy (± other modalities). Retrospective analysis of computed tomography cross-sectional muscle at cervical (C3), thoracic (T2) and lumbar (L3) regions was conducted. Patients were grouped by BMI and sarcopenia status based on established thresholds. A total of 413 patients were included for analysis, the majority having oropharyngeal carcinoma (52 %), and 56 % received primary concurrent chemoradiotherapy. The majority of the cohort (65 %) was overweight or obese (BMI ≥ 25 kg/m^2). Sarcopenia was found in 43 %, with 65 % having SO (*n* 116), equating to 28 % of the whole cohort. Critical weight loss was experienced by 58 % (*n* 238). A significantly higher proportion of patients with SO experienced critical weight loss (*n* 70 *v.* 19, $P < 0{\cdot}001$) and were four times more likely to do so during treatment (OR 4·1; 95 % CI 1·5, 7·1; $P = 0{\cdot}002$). SO was not found to impact on overall or cancer-specific survival; however, in patients with sarcopenia, those with SO had better overall survival (median 9·1 *v.* 7·0 years; 95 % CI 5·2, 16·8; $P = 0{\cdot}021$). SO at the time of presentation in patients with head and neck cancer is predictive of critical weight loss during treatment, and muscle evaluation can be useful in identifying patients at nutritional risk regardless of BMI and obvious signs of wasting.

Keywords: **Head and neck cancer: Sarcopenia: Sarcopenic obesity: Weight loss: Skeletal muscle**

Sarcopenia, or depletion in skeletal muscle mass, has been linked to an increased risk of treatment complications, extended hospitalisations and reduced survival in patients with cancer[1–5]. In head and neck cancer (HNC), radiologically defined sarcopenia, measured by the cross-sectional area (CSA) of skeletal muscle in computed tomography (CT) scans at the third lumbar vertebra (L3), has been shown to be an independent prognostic indicator, with the potential to increase the risk of significant treatment-related toxicities that can also affect outcomes[6–9]. Sarcopenia can occur independent of adiposity; however, changes in body composition occurring with age often include decreased muscle mass and an increase in adipose tissue[10]. It can develop in the absence of a change in body weight, which may mask its presence in patients who are overweight or obese[11–13].

The coexistence of obesity and sarcopenia is known as sarcopenic obesity (SO), where the resultant medical sequelae are potentially more of a serious risk than either sarcopenia or obesity alone [14]. In a 2022 meta-analysis (10 004 patients), the overall prevalence of SO in patients with cancer was 20 % and was significantly associated with worse overall survival (OS), recurrence-free survival and disease-specific survival. In addition, postoperative complications and prolonged length of stay were more prevalent in patients with SO[15]. However, definitions of SO, BMI thresholds and muscle evaluation techniques vary amongst studies.

Abbreviations: CSA, cross-sectional area; CSS, cancer-specific survival; CT, computed tomography; CWL, critical weight loss; HNC, head and neck cancer; OS, overall survival; PET-CT, positron emission tomography-computed tomography; SMI, skeletal muscle index; SO, sarcopenic obesity.

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A recent consensus statement from the European Society for Clinical Nutrition and Metabolism and the European Association for the Study of Obesity, as part of the Global Leadership Initiative on Sarcopenia, recommends the diagnosis of SO including both parameters of skeletal muscle function and evidence of depleted muscle in body composition measures[16]. In the oncology setting, much of the investigation of muscle depletion has made opportunistic use of diagnostic CT scans in retrospective analysis, without including parameters assessing muscle function. As a result, there is heterogeneity in the current literature with regard to diagnostic parameters and few studies that have included measures of function in cancer patients, especially when investigating SO[17]. There is also a paucity of SO research specifically in HNC, making comparisons and applications to this population difficult.

In addition to sarcopenia being prognostic of outcomes in HNC, it is well documented that these patients are at high risk of malnutrition, and many will experience critical weight loss (CWL) as a result of tumour burden and/or treatment-related toxicities[18–20]. Critical weight loss (≥ 5 %) during treatment has been shown to negatively impact outcomes and continues to be of concern in this population[21,22]. Significant muscle depletion can be difficult to detect in patients who are overweight or obese, and it is likely that when CWL occurs during treatment, significant muscle mass is lost. Determining which patients are at the highest risk of CWL during cancer treatment can be difficult with nutritional assessment tools alone, and baseline skeletal muscle measures could aid in detecting depletion in patients who are overweight or obese with no nutritional symptoms.

The aim of this study was to investigate the prevalence of SO and its impact on survival outcomes in patients with HNC treated with curative intent. A secondary aim was to determine predictors of CWL in relation to SO in this population.

Methods

Study design and cohort criteria

This single-institution, retrospective, observational study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients and approved by the local Human Research Ethics Committee, 2019/ETH13149. Written consent was obtained from patients for the use of their treatment-related data for research purposes upon initial consultation at the cancer centre of a large metropolitan tertiary referral hospital in Sydney, Australia. Patients were included if they met the following criteria: adult (≥ 18 years); presented with a newly diagnosed mucosal squamous cell carcinoma (pathology-confirmed) of the head and neck (oropharynx, oral cavity, nasopharynx, hypopharynx or larynx); completed the prescribed curative dose of radiotherapy (± other modalities; surgery/chemotherapy) at the cancer centre between 2005 and 2022; and received a diagnostic positron emission tomography-computed tomography (PET-CT) scan or radiotherapy planning CT scan deemed suitable for analysis. Exclusion criteria included previous cancer diagnosis or treatment (including excisions), patients with metastatic disease or treated with palliative intent and unclear or incomplete PET-CT or CT scan. Eligible patient information was collected from medical records and included measures of height and weight taken within one week of receiving a scan.

Skeletal muscle analysis

CT images were evaluated by a single observer (BV) trained in CT body composition analysis. Muscle tissue density data were quantified using Slice-O-Matic Version 5·0 (Tomovision) and identified using Hounsfield units of −29 to +150HU[23,24]. Skeletal muscle was measured via the CSA in a single axial slice at the level of the third lumbar vertebra (L3) in patients with PET-CT scans and at the second thoracic vertebra (T2) or the third cervical vertebra (C3) in radiotherapy planning scans of patients who had not received a PET-CT. Landmarking at the three vertebral levels was as per previously defined techniques for L3[25], T2[26] and C3[27]. Where muscle CSA at T2 and C3 was measured, prediction models were applied to estimate CSA at the level of L3[26,28].

Model applying T2 measures[26]:

L3-CSA (cm^2) = 174·15 + (0·212 × T2-CSA (cm^2)) − (40·032 × Sex) − (0·928 × Age (Years)) + (0·285 × Weight (kg))

Model applying C3 measures[28]:

L3-CSA = 124·838 + (1·881 × C3-CSA (cm^2)) − (24·687 × Sex) − Age (Years) + (0·472 × Weight (kg))

(in both models – for sex, use a value of '1' for males and '2' for females)

Sarcopenia assessment

Actual CSA measures at L3 (where available) and predicted L3-CSA (in patients with no L3) were used to assess sarcopenia status in each patient. CSA was normalised for stature (height^2), and the skeletal muscle index (SMI, cm^2/m^2) was used for sarcopenia classification. BMI and sex-specific thresholds defined by Martin *et al.*[29] were applied in patient categorisation. BMI classifications (in kg/m^2) were underweight (BMI < 20·0), healthy weight (BMI 20·0–24·9), overweight (BMI 25·0–29·9) or obese (BMI ≥ 30·0). The presence of sarcopenia was defined as SMI < 41 cm^2/m^2 in females (regardless of BMI), < 43 cm^2/m^2 (underweight or healthy weight) and < 53 cm^2/m^2 (overweight or obese) in males. Patients were categorised as having SO if SMI values were below the threshold and BMI was ≥ 25 kg/m^2. Sub-analysis was also conducted on the obese population (BMI ≥ 30 kg/m^2) for comparison.

Critical weight loss

Critical weight loss was defined as a weight loss of ≥ 5 % during radiotherapy treatment (up to 6 weeks). Weight was recorded prior to commencement of treatment (at presentation or at the time of the scan) and in the final treatment week. Weight loss was calculated at the end of treatment as a percentage of initial weight.

Statistical analysis

Categorical data were summarised using frequencies or percentages and continuous data with mean and SD for normally distributed data or median and interquartile range (IQR) for non-

normally distributed data. The normality of data distribution was determined using the Shapiro-Wilk test. Patients were dichotomised by CWL status as the independent variables, and univariate association with patient characteristics was analysed using binary logistic regression. Variables were chosen based on the potential impact on weight change and at the univariate level included age, sex, tumour site, treatment modality, sarcopenia, SO, T-stage and N-stage. Variables with a $P < 0{\cdot}20$ at the univariate level were included in the multivariable model while controlling for confounders with a backward stepwise approach to obtain adjusted OR. Variables that did not meet the $P < 0{\cdot}20$ criteria at the univariate level were considered for their potential confounding and included in the final model. OS and cancer-specific survival (CSS) were compared between groups using the Kaplan–Meier method, with the difference in curves assessed by the log rank for hazard ratios. Survival was calculated from the date of the CT scan (prior to treatment commencement) to the last date of follow-up or death from any cause (for OS) and death from HNC (for CSS). For all statistical analyses, significance was set at $P < 0{\cdot}05$ (2-sided), and all analysis was conducted using SPSS Version 27 (IBM).

Results

Scans of 413 patients were analysed (C3 = 75, T2 = 250, L3 = 88). In the eighty-eight patients who had a PET-CT scan, the median time frame between the scan and treatment commencement was 2 weeks (IQR 1–3). The remaining patients had a radiotherapy planning scan within 1 week of treatment commencement. The majority of the cohort was male (84 %) with a mean (SD) age of 60 ± 11 years. Most patients had an oropharyngeal tumour (52 %), with 56 % of patients undergoing concurrent chemoradiotherapy as primary curative treatment. All patient characteristics are displayed in Table 1.

The majority of patients presented as being overweight or obese (*n* 267, 65 %), with 42 % (*n* 99) having a BMI ≥ 30. Sarcopenia was present in 43 % of the cohort (*n* 177), and of these patients, 65 % were overweight or obese (*n* 116 with SO). Therefore, 28 % of the whole cohort presented with SO. The majority of patients lost weight during treatment (85 %), with a mean loss of 6·7 % (SD 3·9). In patients with sarcopenia, there was a significant difference in total percentage weight loss between those with SO and those without (5·8 % *v.* 3·3 %; 95 % CI −3·7, −1·4; $P < 0{\cdot}001$) (Fig. 1).

Fifty-eight percent of patients (*n* 239) experienced CWL. In patients with sarcopenia, half experienced weight loss ≥ 5 % (*n* 89), and significantly more patients with SO had CWL (*n* 70 *v.* 19, $P < 0{\cdot}001$).

In the subset of patients with BMI ≥ 30 kg/m^2, 22 % (*n* 22) were sarcopenic, and there was no difference in the mean percentage weight loss experienced by these patients when compared with others who were sarcopenic (6·4 % *v.* 4·8 %; 95 % CI −3·5, 0·2; $P = 0{\cdot}074$); however, the majority of these patients did experience CWL (*n* 16, 73 %).

The variables included in the multivariable logistic regression model are shown in Table 2. The final model demonstrated that patients with SO were four times more likely to experience CWL (OR 4·1; 95 % CI 1·8, 9·5; $P = 0{\cdot}001$). Additional parameters predictive of CWL were oropharynx tumours (OR 3·3; 95 % CI 1·5, 7·1; $P = 0{\cdot}002$), nasopharynx tumours (OR 8·8; 95 % CI 2·9, 26·5; $P < 0{\cdot}001$), increasing age (OR 1·0; 95 % CI 1·03, 1·00; $P = 0{\cdot}031$), females (OR 2·3; 95 % CI 1·1, 5·1; $P = 0{\cdot}032$) and

Table 1. Patient characteristics
(Numbers and percentages; mean values and standard deviations; median values and interquartile ranges)

	Whole cohort *n* 413 (%)		Sarcopenic obesity *n* 116 (%)	
	n	%	*n*	%
Sex				
Male	348	84	99	85
Female	65	16	17	15
Age (years)				
Mean	60		64	
SD	11		10	
Tumour site				
Larynx	79	19	24	21
Hypopharynx	18	4	6	5
Oropharynx	215	52	67	58
Nasopharynx	44	11	7	6
Oral cavity	55	13	12	10
Unknown primary	2	1	–	
Staging*				
T-classification				
Tis	3	1	1	1
T1	126	30	36	31
T2	113	27	36	31
T3	101	25	33	28
T4	66	16	10	9
Tx	4	1	–	
N-classification				
N0	132	32	46	40
N1	104	25	21	18
N2	157	38	42	36
N3	20	5	7	6
Treatment modality				
RT only	104	25	42	36
RT + surgery	79	19	21	18
CRT (± surgery)	230	56	53	46
RT dosage (Gy)				
Median	68		68	
IQR	6		6	
Fractions completed				
Median	34		34	
IQR	3		3	
Chemotherapy agent	*n* 231		*n* 52	
Cisplatin	199	86	44	84
Cisplatin + 5FU	11	5	4	8
Cetuximab	20	9	4	8
HPV status				
Positive	140	34	43	37
Negative	23	6	8	7
Unknown	251	60	65	56
Sarcopenia				
Yes	177	43	–	
No	236	57	–	
BMI				
< 25 kg/m^2	146	35	–	
≥ 25 kg/m^2	267	65	–	
Sarcopenic obesity†				
Yes	116	65	–	
No	61	35	–	

Tis, tumour insitu; RT, radiotherapy; CRT, concurrent chemoradiotherapy; Gy, grey; IQR, interquartile range; HPV, human papillomavirus; FU, fluorouracil.
* 7th Ed. UICC TNM classification of malignant tumours.
† In patients with sarcopenia (*n* 177).

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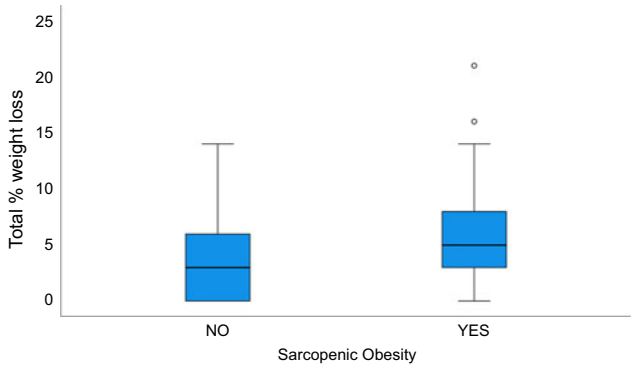

Fig. 1. Difference in weight loss in the subset of patients with sarcopenia.

concurrent chemoradiotherapy treatment (OR 4·7; 95 % CI 2·4, 9·3; $P < 0·001$).

In survival analysis, the median (IQR) time to follow up was 4 (1–8) years, and there was no difference in both OS and CSS when comparing patients with and without SO (Fig. 2(a) and (b)). A significant difference was found, however, when comparing OS in patients with sarcopenia without stratification by BMI (log rank $P = 0·006$; median survival 8·4 *v.* 10·1 years; 95 % CI 4·0, 12·0; 5 years OS of 55 % *v.* 74 %) (Fig. 3). However, this was not significant for CSS (log rank $P = 0·053$; median survival 10·7 *v.* 12·1 years; 5 years CSS of 72 % *v.* 81 %). A significant difference was found in OS again when comparing those with SO in the subset of patients with sarcopenia; however, patients with SO had better OS (median survival 9·1 *v.* 7·0 years; 95 % CI 5·2, 16·8; $P = 0·021$; 5 years OS of 60 % *v.* 46 %) (Fig. 4). No significant difference was found when comparing OS and CSS in analysis with the BMI ≥ 30 kg/m^2 subset of patients with sarcopenia.

Discussion

This novel study has investigated SO in relation to CWL risk in patients with HNC. Our findings have demonstrated that SO at presentation is predictive of CWL during treatment in this cohort of patients. Although SO was not found to impact on OS or CSS in the whole cohort, these patients experience clinically significant weight loss during treatment and may not be identified as being 'at risk' at the time of presentation due to their overweight or obese status.

Few studies have investigated SO in patients with HNC, and those that have varied in diagnostic parameters as well as methodology for skeletal muscle measurement. Bonavolonta *et al.* investigated SO in patients with oral squamous cell carcinoma in an Italian cohort, applying measures of skeletal

Table 2. Logistic regression analysis for critical weight loss predictors (Odds ratios and 95 % confidence intervals)

	Univariate			Multivariate		
Clinical variables	OR	95 % CI	*P*	OR	95 % CI	*P*
Sex						
Male	Ref					
Female	0·93	0·54, 1·61	0·804	2·34	1·08, 5·07	**0·032**
Age (years)	0·98	0·96, 0·99	**0·009**	1·03	1·00, 1·06	**0·031**
Tumour site						
Larynx	Ref					
Hypopharynx	1·20	0·40, 3·57	0·749			
Oropharynx	5·75	3·25, 10·16	< **0·001**	3·31	1·54, 7·12	**0·002**
Nasopharynx	10·76	4·34, 26·67	< **0·001**	8·76	2·90, 26·52	< **0·001**
Oral Cavity	1·47	0·71, 3·07	0·295			
Staging*						
T-classification						
T1	Ref					
T2	1·34	0·79, 2·28	0·275			
T3	0·88	0·52, 1·50	0·639	0·38	0·17, 0·82	**0·014**
T4	0·50	0·27, 0·92	**0·025**			
N-classification						
N0	Ref					
N1	1·72	10·2, 2·91	**0·042**			
N2	4·19	2·54, 6·93	< **0·001**			
N3	3·19	1·14, 8·92	**0·027**			
Treatment						
Primary RT	Ref					
Surgery + RT	0·49	0·26, 0·93	**0·029**			
CRT	4·72	2·86, 7·82	< **0·001**	4·69	2·35, 9·34	< **0·001**
Sarcopenic obesity						
No	Ref					
Yes	1·19	0·77, 1·85	0·444	4·09	1·75, 9·54	**0·001**
Sarcopenia						
No	Ref					
Yes	0·59	0·40, 0·88	0·009			

RT, radiotherapy; CRT, concurrent chemoradiotherapy.
* 7th Ed. UICC TNM classification of malignant tumours. Values in bold indicate significance ($P<0.05$).

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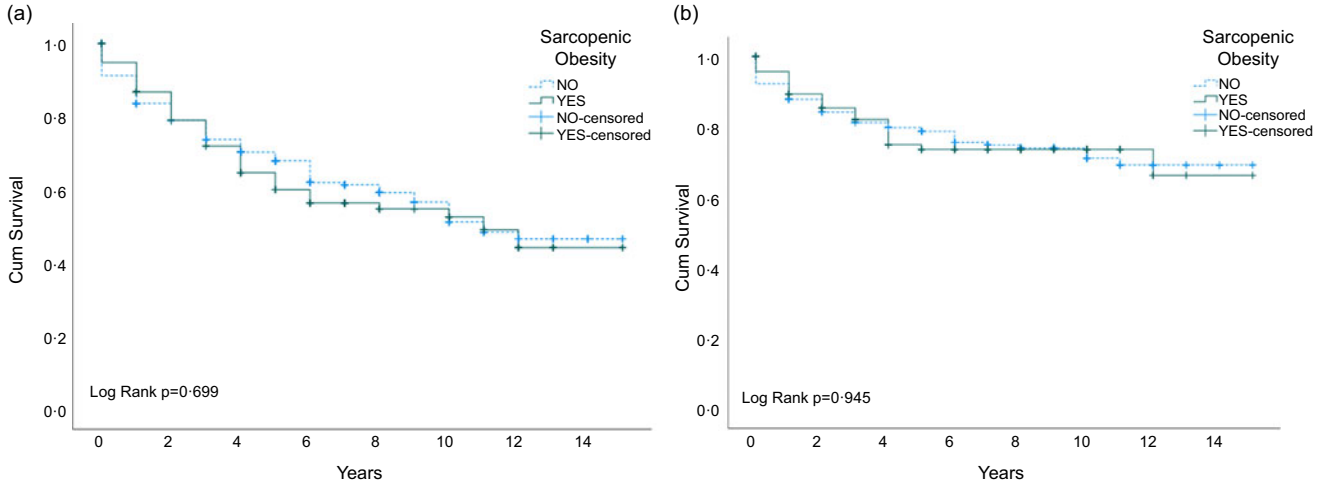

Fig. 2. Sarcopenic obesity survival analysis. (a) Overall survival and (b) cancer-specific survival.

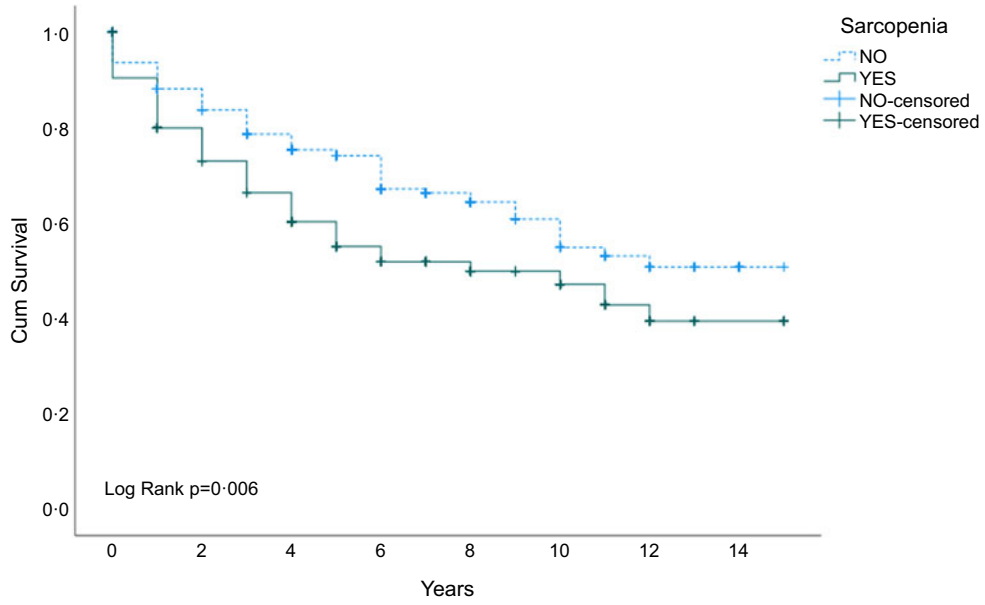

Fig. 3. Sarcopenia and overall survival across the whole cohort.

muscle at C3 (as predictive measures at L3) and defining SO as low skeletal muscle combined with a BMI threshold for obesity of ≥ 27 kg/m^2[30]. In 426 patients, only ten (2 %) had SO. Similarly, Chargi *et al*. identified only 6 % (*n* 13) of patients using the same diagnostic parameters in the Netherlands[31]. No rationale for the use of the BMI threshold of 27 kg/m^2 was provided by either study. A Mexican study of seventy-one patients with heterogeneous HNC found the prevalence of SO was 28 % (*n* 20), defined using the BMI threshold of ≥ 25 kg/m^2. However, skeletal muscle mass was measured using bioelectric impedance and not via CT scan analysis[32]. We found a similar proportion of our cohort with SO (28 %) and a much higher number compared with the two previously mentioned studies, potentially due to the higher BMI cut-off used. In this Australian cohort, patients who were overweight or obese represented 65 % of the population and is indicative of the Australian population in general, with 67 % estimated as being overweight or obese in 2017–2018[33]. The relatively small numbers of patients with SO in other studies may be indicative of the lower proportion of patients who are overweight or obese in those countries compared with Australia. The coexistence of sarcopenia and obesity may go undetected with anthropometric tools alone, and this study has highlighted the importance of additional body composition assessment, especially where BMI can mask muscle depletion.

In the present study, the definition of sarcopenia applied sex- and BMI-specific thresholds for SMI introduced by Martin *et al*., where the BMI cut-off was set at ≥ 25 kg/m^2[29]. As this BMI threshold was utilised to determine low muscle mass, it was also used to classify patients as having SO. Several other studies in various cancer cohorts have included patients who were both overweight and obese (≥ 25 kg/m^2) to define those in the SO

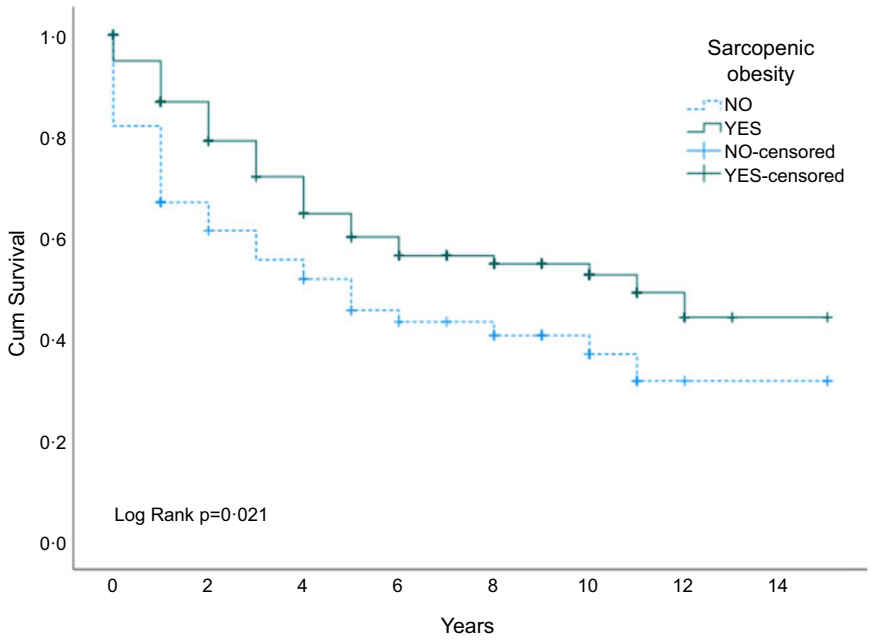

Fig. 4. Overall survival in a subset of patients with sarcopenia.

category as a coexistence of obesity and sarcopenia as a distinct diagnosis[17,34–36].

We applied the BMI threshold of ≥ 25 kg/m^2 in order to include all patients who were either overweight or obese. In our Australian cohort, the median BMI was 27 kg/m^2. With such a large proportion of patients who are overweight or obese, there may be a misconception of adequate skeletal muscle stores based on the lack of obvious, visible signs of muscle wasting. We found that by including these patients, we were able to identify 116 patients who were sarcopenic despite being overweight or obese. Only including those defined specifically as 'obese' (BMI ≥ 30 kg/m^2) would limit diagnosis and potentially fail to identify additional patients at risk. Considering our finding that patients with SO were significantly more likely to experience CWL, the inclusion of those who are also in the overweight category was effective in screening for those at the highest risk. Our analysis conducted using the BMI ≥ 30 kg/m^2 criteria for SO also identified these patients who experienced CWL. However, no difference in survival outcomes was found, and this may be due to the small sample size in this analysis (n 22 with BMI ≥ 30 plus sarcopenia), and further investigations should be conducted in larger populations to explore this further.

Critical weight loss during radiotherapy has been reported in HNC in several studies, and a higher BMI has been shown to be predictive of weight loss during treatment[37,38]. As highlighted in the present study, we have identified that patients with a high BMI combined with low SMI had a higher risk of CWL during radiotherapy. To our knowledge, this has not been previously demonstrated. The typical characteristics of patients with HNC have changed in recent years, with fewer patients presenting with obvious malnutrition (especially those with human papillomavirus-positive disease); we have demonstrated the importance of comprehensive muscle mass assessment and considering more than BMI at the time of baseline nutritional assessment. As previously mentioned, BMI may mask the presence of muscle depletion, and ideally all patients should be appropriately considered and screened for risk, regardless of visible adiposity or lack of nutritional symptoms affecting oral intake.

In a systematic review (2020), Donini *et al.* raised concerns about the heterogeneity of diagnostic criteria for SO and a lack of consensus in the literature at the time on which parameters should be applied[39]. The recent consensus statement addresses these concerns with recommendations for SO definition and diagnostic criteria[16]. However, as mentioned earlier, much of the current research into sarcopenia in patients with cancer has made opportunistic use of diagnostic CT scan images for retrospective analysis. Many cancer centres do not currently have routine assessments of skeletal muscle functional status, and this is a limitation of any retrospective data investigations. Future prospective research regarding SO should include functional assessment as an additional criterion; however, for this particular study, we have only used CT-defined sarcopenia combined with BMI for patient diagnosis as functional status was not available.

SO did not appear to impact survival outcomes. Interestingly, however, when analysis was conducted to compare survival in the subset of patients who were sarcopenic, those with SO had comparatively better OS than patients who were not overweight or obese. This may be due to the high proportion of patients with oropharynx cancer in the overweight/obese category. It has been well established that patients with human papillomavirus-positive oropharyngeal carcinoma have better survival rates[40], and those with a BMI ≤ 25 kg/m^2 have been shown to have worse survival than overweight or obese patients[41]. We were unable to investigate the added impact of human papillomavirus as a high percentage of the cohort had unknown status. A higher BMI may be protective for survival in HNC[42]; however, this

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study has shown that sarcopenia continues to impact on survival regardless of BMI. Fattouh *et al.* had similar findings, suggesting that compared with BMI in this population, sarcopenia is likely a better prognostic indicator[43].

Despite this, the number of patients experiencing CWL is high in this population and remains a clinical concern. There are varied results in the literature when investigating the impact of weight loss on survival and clinical outcomes in HNC, likely due to the heterogeneity of tumour sites investigated, variation in time points for weight change data (e.g. end or treatment *v.* months post) and definitions for 'critical' weight loss[22,44,45]. Weight loss experienced by patients with HNC is mostly likely an indication of nutritional inadequacy and is of high clinical significance regardless of impact on survival.

There are several limitations to this study, including it being conducted in a single centre and its retrospective nature. Patient numbers were maximised through muscle analysis at three vertebral levels and the application of previously validated prediction models[26,28]. Full-body PET-CT scans are not routine in our facility for patients with HNC, and this methodology allowed the inclusion of a larger cohort. The use of radiotherapy planning CT scans provides additional opportunities for muscle mass evaluation in patients with HNC. The use of prediction models may introduce some degree of error that requires consideration when interpreting results. The CSA of muscle at the level of L3 is a surrogate measure for whole-body muscle, and predictions of this value using alternate muscle groups should be applied with caution. Nevertheless, skeletal muscle evaluation would not be clinically applied in isolation and would include a full nutritional assessment incorporating additional parameters to diagnose nutritional and muscle status. Importantly, almost half of the overweight or obese patients in our cohort had low skeletal muscle mass at baseline, and muscle evaluation may identify patients at risk where there may not be other obvious nutritional issues. The majority of the cohort was male, which, although representative of the typical HNC population, did not allow for sex-specific comparisons with regard to SO. This study has defined sarcopenia radiologically, without functional assessment, as all data were collected retrospectively. Ideally, future work should be of a prospective nature, with the inclusion of functional parameters, as per the consensus statement[39] and future research recommendations[46], to provide a more robust SO diagnosis specific to patients with HNC and better guide future practice.

Conclusions

Patients with HNC who present with SO at the time of diagnosis are more likely to experience CWL during treatment. Muscle mass evaluation should be considered in routine nutritional assessment to ensure patients with muscle depletion are identified regardless of visible adiposity or BMI, to ensure appropriate and timely nutritional intervention.

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