Original Article

Dysphagia in Solid Tumors Outside the Head, Neck or Upper GI Tract: Clinical Characteristics

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Abstract

Context. Dysphagia is common in cancer, but underlying pathophysiology and manifestations within patients are unknown.

Objectives. To examine dysphagia characteristics in those with solid malignancies outside the head, neck and upper gastrointestinal tract.

Methods. Seventy-three individuals with dysphagia (46 male, 27 female, aged 37-91) were recruited from a parent trial conducted in two acute hospitals and one hospice. Cranial nerve function, Oral Health Assessment Tool (OHAT), Mann Assessment of Swallowing Ability (MASA) and Functional Oral Intake Scale (FOIS) evaluated swallow profile.

Results. Only 9/73 (12%) had documented dysphagia prior to study enrollment. MASA risk ratings found *n*=61/73 (84%) with dysphagia risk and *n*=22/73 (30%) with aspiration risk. Food texture modification was required for *n*=34/73 (47%), fluid texture modification for *n*=1/73 (1%). Compensatory strategies for food were needed by *n*=13/73 (18%) and for fluids by *n*=24/73 (33%). Cranial nerve deficits were present in *n*=43/73 (59%). Oral health problems were common, with xerostomia in two-thirds. Worse dysphagia on MASA was associated with disease progression, affecting hospice, and palliative care the most. Worse performance status was indicative of poorer MASA raw score ($P<0.001$, OR 2.2, 95% CI 1.5−3.4), greater risk of aspiration ($P=0.005$, OR 2.1, 95% CI 1.3-3.6) and lower FOIS ($P=0.004$, OR 2.0, 95% CI 1.2−3.2).

Conclusion. Dysphagia management in those with cancer requires robust assessment to uncover clinically important needs like food texture modification and safe swallowing advice. Better assessment tools should be developed for this purpose. Oral health problems should be routinely screened in this population since they exacerbate dysphagia. J Pain Symptom Manage 2022;64:546−554.

Key Words

Dysphagia, Neoplasms, Cancer, Diagnosis, Palliative care, Solid tumors

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Key message

This is study used swallow evaluation to examine characteristics and implications of dysphagia in those with solid cancers outside the head, neck and upper GI tract. Dysphagia was associated with oral health difficulties, cranial nerve problems and disease progression. Patients required advice on how to safely and efficiently swallow food.

Introduction

Dysphagia in cancer is usually associated with head, neck or esophageal cancers. Recent research revealed it is common in cancers outside anatomic swallow regions. Kenny et al.[1] used multimodal swallow examination in 385 individuals with primary solid malignancies outside the head, neck and upper gastrointestinal tract (GI) tract, where dysphagia prevalence was 19%. Those under palliative care (PC), in hospice, or with worse overall performance status were most at risk. Dysphagia was also associated with poorer overall quality of life. Frowen et al.[2] conducted a similar study with patient-reported swallowing difficulties as a diagnostic criterion. They identified a prevalence of 49% for solid tumors outside swallow regions.

Multiple potential mechanisms for dysphagia in this population have been hypothesized. Radiotherapy may exacerbate dysphagia in radiosensitive organs of the upper aerodigestive tract from fibrosis, mucositis, and xerostomia.[3,4] These organs are usually spared during radiotherapy for cancers outside anatomic swallow regions, except perhaps lung cancer, where proximity of the esophagus may increase risk.[3,5] Chemotherapy induces mucositis, which may cause a painful swallow and is associated with anorexia, dehydration and malnutrition.[6,7] Both radio- and chemotherapy are also associated with dysgeusia (altered taste) and dysosmia (altered smell).[3,8,9] While these may not directly cause dysphagia, chemosensory input modulates swallow responsiveness, with increased sensory input providing better swallow response.[10] Targeted (or biological) therapies refer to drugs that interfere with carcinogenesis and tumor growth.[11] Their impact on swallow function is unknown, though they cause taste changes to a greater extent than other treatment modalities.[12]

Oropharyngeal colonization by candida is highly prevalent amongst those undergoing anti-tumor treatment. One study[13] found an overall prevalence of almost 10%; rates were highest for chemoradiation, or those on two or more cytotoxic agents. Candida induced odynophagia, taste changes, and xerostomia, which adversely affected swallow efficiency, enjoyment, and safety.

Some specific tumor locations may directly interfere with swallow function, such as lung cancer, which may induce dysphagia through various mechanisms like interruption of the breath/swallow cycle, esophageal compression, tracheoesophageal tumor invasion or vagus nerve compression.[14,15] Similarly, primary brain tumors or brain metastases may directly interfere with neurological swallow function.[16,17]

Clinical bedside swallow evaluation is a critical component of dysphagia diagnosis. This comprises a detailed history, general patient status (physical and cognitive evaluation), cranial nerve examination, oral cavity inspection, and direct patient observation when swallowing different food and fluid consistencies.[18,19] These items form a 'core set' that are routinely evaluated to support a dysphagia diagnosis.[20] This accounts for variations in pathophysiology and diseases which cause swallowing difficulties. A multimodal approach to dysphagia diagnosis is therefore recommended.[18–20]

While previous studies have screened for dysphagia in those with primary cancers outside the head, neck and upper GI tract, none have diagnosed dysphagia by multimodal assessment nor identified characteristics. We wished to understand the clinical need to assess and manage swallowing difficulties in this complex population. Research objectives were to quantify dysphagia severity, characterize pathophysiological deficits and determine associations between these. This research was novel, so no *a priori* hypotheses were considered.

Methods

Design

Data collection was completed cross-sectionally, once for each participant and lasted 24 weeks. Data were collected by the first author who is an advanced dysphagia practitioner. STROBE[21] guided study conduct and reporting. Ethical approval was obtained from the Research Ethics Committees of each recruitment setting. Written informed consent was obtained from participants.

Recruitment

Participants were recruited consecutively from two acute hospitals and one hospice under either private or public health care services. Care was led by Medical Oncology (MO), Radiation Oncology (RO), or PC teams, who referred individuals to the study. Participants attended in-patient (IP), out-patient (OP), oncology day ward (DW), or day hospice (DH). Those in DW were receiving anti-tumor treatments. Those in DH received a nurse-led, multidisciplinary rehabilitation service.

Inclusion/Exclusion

Participants were adults (≥18) with active primary solid malignancies outside the head, neck or upper GI tract. They were aware of their diagnosis and spoke English. Those deemed by their supervising clinician to

be too unwell to participate (e.g. actively dying, acutely distressed) were excluded. Also excluded were individuals with non-solid tumors, or current/past primary cancer of the head, neck or upper GI tract.

Sample

Our sample was part of a larger study, which investigated dysphagia prevalence and predictors in adults with solid malignancies outside the head, neck, and upper GI tract.[1] That study recruited 385 individuals by consecutive sampling and screened them for dysphagia. Eating Assessment Tool (EAT-10)[22] was chosen for screening because it was validated on a mixed-disease population. A score ≥3 was a positive screen per test instructions. Participants were then asked whether they noticed difficulty chewing or swallowing since their cancer diagnosis, based on a previously validated screening question.[23] A 'yes' to either question was a positive screen, unless the difficulty was historical and fully resolved. In total, *n*=73/385 (19%) met criteria to proceed to full evaluation and were ultimately included. Of these, *n*=10/73 (14%) were not identified by EAT-10, but rather the additional screening questions. Participant characteristics were independent variables (Table 1).

Screening Phase

Screening captured participants' general cognitive, physical and psychological health to identify potential associations with dysphagia severity. Cognitive status was determined by 4AT,[24] where scores ≥3 indicate impaired cognition. Performance status was by ECOG-PS,[25] where 0 indicates best and 4 worst physical function. Global quality of life was rated 0 (worst) to 10 (best) on a linear analogue scale.[26] Aerodigestive and nutritional symptoms were captured because they commonly co-occur with dysphagia[27,28] and were marked as present or absent within the last week. Height and weight allowed calculation of weight loss and cachexia diagnosis using international consensus guidelines.[29] If documented height and weight data were available, these were given priority over self-report.

Each participant's cancer diagnosis and profile, chemistry/hematology results (albumin, c-reactive protein, neutrophil-to-lymphocyte ratio), number of comorbidities and treatment history were captured to reflect overall health. All screening items are in the supplemental file and were independent variables.

Dysphagia Evaluation

Those with a positive dysphagia screen were evaluated multimodally. A full list of evaluation items is in the supplemental file. Participants described potential swallowing and food/fluid intake issues using two open questions, similar to a clinical case history.

Table 1
Participant Demographic and Clinical Characteristics

Characteristic	*n*=73
Mean age *(SD, range)*	66 (±13, 37–91)
Sex, *n (%)*	
Male	46 (63%)
Female	27 (37%)
Primary cancer site, *n (%)*	
Colorectal	18 (25%)
Lung	15 (21%)
Kidney	9 (12%)
Prostate	10 (14%)
Pancreas	4 (5%)
Bladder	3 (4%)
Breast	3 (4%)
Mesothelioma	3 (4%)
Other (cervix, gallbladder, mediastinum, melanoma, ovary, sarcoma, testicle, thymus)	1 (1%)
Disease extent, *n (%)*	
Metastatic	47 (64%)
Locoregional	26 (36%)
Mean time since diagnosis *(SD)*	24 months (±30)
Health care organization, *n (%)*	
Public	42 (58%)
Private	28 (38%)
Unknown	3 (4%)
Setting, *n (%)*	
Hospital	49 (67%)
Hospice	24 (33%)
Patient location, *n (%)*	
IP	41 (56%)
DW	14 (19%)
OP	12 (16%)
DH	6 (8%)
Primary health care team, *n (%)*	
MO	43 (59%)
PC	27 (37%)
RO	3 (4%)
Ongoing anti-cancer treatment, *n (%)*	
Yes	53 (73%)
No	20 (27%)

1) Can you tell me about any changes to your eating or drinking habits since you were diagnosed?
2) Are you avoiding any particular foods or drinks since you were diagnosed? [If 'yes':] Why?

Responses were transcribed verbatim. These questions yielded large amounts of information about patient experiences and will be reported separately.

Sensory and motor cranial nerve function were examined with a protocol adapted from two published sources.[30,31] Cranial nerves V, VII, IX, X, XII were rated as 'impaired' or 'unimpaired' and were independent variables.

Oral health was screened by the Oral Health Assessment Tool (OHAT).[32] OHAT rates severity of oral problems by scoring affected structures and physiology. Scores range from 0 (no problems) to 16 (worst oral health). Since OHAT does not discretely diagnose dry mouth, lingual coating, or mucositis, a schema was developed to identify these dysphagia-related features (see supplemental file). OHAT scores and conditions were independent variables.

Mann Assessment of Swallowing Ability (MASA)[33] was used based on a systematic review.[34] MASA generates a score out of 200, where lower scores indicate worse dysphagia. It also allows raters to judge dysphagia and aspiration presence as 'unlikely', 'possible', 'probable', or 'definite', by Ordinal Risk Ratings (ORRs). ORRs are based on assessment observations and not self-report. These were dependent variables.

MASA requires administration of liquid and solid bolus items. The International Dysphagia Diet Standardization Initiative (IDDSI) framework[35] was used to describe textures. Room temperature still water (*Irish Spring Water*; Dunnes Stores, Dublin, Ireland) was for fluid trials (IDDSI 0). A choice of yoghurt (*Petit Filou*; Yoplait, Dublin, Ireland) or custard (*Deliciously Creamy Custard*; Sunny South, Dublin, Ireland) were for purée trials (IDDSI 4). A digestive biscuit (*Boland's Digestives*; Jacob Fruitfield Food Group, Dublin, Ireland) was for regular trials (IDDSI 7). To avoid excluding those with food intolerances, gluten-free (*Gluten Free Digestive*; Schär, Burgstall, Italy; IDDSI 7), sugar-free (*Sugar Free Digestive Biscuits*; Gullón, Palencia, Spain; IDDSI 7), and dairy-free (*Simply Plain*; Alpro, Ghent, Belgium; IDDSI 4) alternatives were offered and available. All IDDSI 4 items were comparable using spoon tilt testing.[36]

Participants with difficulties during swallow trials were recommended compensatory swallow strategies involving advice (e.g. a drink to moisten the bolus) or postural adjustments (e.g. chin tuck). Difficulties included overt signs of penetration/aspiration (e.g. coughing), and observed or self-reported problems (e.g. post-swallow pharyngeal residue sensation). If recommendations did not improve swallow safety or efficiency with fluids, they were progressed to more viscous IDDSI consistencies (*Nutilis Clear*, Nutricia, Amsterdam, Netherlands).

Functional Oral Intake Scale (FOIS)[37] graded participants' degree of diet modification or restriction. This rates diet from 1 (nil by mouth) to 7 (total oral diet with no restrictions). Scores were based on MASA and self-reported swallow difficulties and were a dependent variable. FOIS scores were unaffected by non-swallow dietary restrictions like food avoidance from nausea.

Dysphagia Diagnosis

Any one or more of the following was a positive diagnosis.

1) Self-reported swallowing difficulties during open questions (e.g. coughing, choking on intake)
2) MASA score ≤177
3) MASA dysphagia or aspiration ORR other than 'unlikely'
4) Participant required compensatory swallow strategy
5) FOIS <7

All 73 individuals who screened positively for potential dysphagia were confirmed to have it and included. Of these, *n*=9/73 (12%) had prior documented dysphagia, *n*=2/73 (3%) had received swallow assessment and/or management. Median number of diagnostic criteria met was 3 (IQR=2). Diagnosis from self-reported difficulties only was *n*=4/73 (5%).

Statistical Analysis

Statistical analysis was with SPSS 25.0 (IBM Corporation, NY) and Minitab 17 (Minitab Inc., PA). Percentage values were rounded to the nearest whole number (rounding errors apply). Predictors of worse MASA and FOIS were examined by univariate and multivariate ordinal logistic regression. Where data were missing, these were excluded from analysis and reported. All test assumptions were met and significance was α=0.05. A multivariate saturated model was created. Predictors were removed iteratively, the least significant predictor taken out each time. Concordant pairs and Pearson values were examined to improve model fit.

Results

Cranial Nerves

Abnormal cranial nerve function was found in *n*=43/73 (59%). No participant had sensory trigeminal (CN V) problems, while *n*=8/73 (11%) had motor difficulties. Motor problems in the facial (CN VII) nerve was present in *n*=4/73 (5%). Two (3%) had glossopharyngeal (CN IX) sensory issues. Vagus (CN X) motor abnormalities were evident in *n*=32/73 (44%), hypoglossal (CN XII) motor in *n*=29/73 (40%).

Oral Health

Mean and median Oral Health Assessment Tool (OHAT) scores were 3/16, range 0−11. Dry mouth was observed in *n*=48/73 (66%), lingual coating *n*=28/73 (38%), denture use *n*=25/73 (34%) and mucositis *n*=18/73 (25%).

Mann Assessment of Swallowing Ability (MASA)

Mean MASA score was 190.9 (95% CI 188.8−193), median 194, range 161−200. Chest infection, crepitations or sputum were present in *n*=27/73 (37%), cough response to bolus administration in *n*=23/73 (32%). The MASA test manual generated severity ratings and identified impaired swallow phases (Table 2).

Post-Assessment Dietary Recommendations

These were based on multimodal swallow evaluation, including self-reported difficulties from open questions. They included regular (IDDSI 7) foods (*n*=39/73; 53%), soft and bite-sized (IDDSI 6; *n*=23/73; 32%), minced and moist (IDDSI 5; *n*=10/73; 14%) and

Table 2
Mann Assessment of Swallowing Ability Outcomes

Finding	*n*/73 (%)
Dysphagia severity rating	
Nil	66/73 (90%)
Mild	4/73 (5%)
Moderate	3/73 (4%)
Aspiration severity rating	
Nil	70/73 (96%)
Mild	3/73 (4%)
Moderate	0/73 (0%)
Dysphagia ORR	
Unlikely	12/73 (16%)
Possible	10/73 (14%)
Probable	14/73 (19%)
Definite	37/73 (51%)
Aspiration ORR	
Unlikely	51/73 (70%)
Possible	15/73 (21%)
Probable	4/73 (5%)
Definite	3/73 (4%)
Swallow stage affected	
Pharyngeal	52/73 (71%)
Oral preparatory	41/73 (56%)
Oral	39/73 (53%)
>1 Phase affected	45/73 (62%)

puréed (IDDSI 4; *n*=1/73; 1%). One participant required fluid modification to mildly thick (IDDSI 2), all others tolerated thin (IDDSI 0) fluids. Compensatory swallow strategies were required by *n*=13/73 (18%) for food and *n*=24/73 (33%) for fluids to improve swallow safety and/or efficiency. Food strategies were: moisten foods (*n*=8/13; 62%), avoid dry/crumbly foods (*n*=5/13; 38%), alternate food and fluids to aid clearance (*n*=4/13; 31%), avoid tough/chewy foods (*n*=2/13; 15%), chin tuck (*n*=1/13; 8%), chop food finely (*n*=1/13; 8%). Fluid strategies were: single, discrete sips (*n*=15/24; 63%), altering taste or temperature (*n*=4/24; 17%), chin tuck (2/24; 8%), chin tuck with head turn (1/24; 4%). In total, *n*=63/73 (86%) required dietary modification, restriction and/or compensatory strategies for swallowing problems. Of the remaining ten participants, *n*=6/73 (8%) had observable swallow difficulties, *n*=4/73 (5%) did not. Both groups also self-reported difficulties at home. No specific dietary advice or recommendations could be provided.

Functional Oral Intake Scale (FOIS) scores were generated by the researcher for those with dysphagia. Scores were also available for the *n*=312 participants without dysphagia based on self-reported diet (Table 3).

Mann Assessment of Swallowing Ability (MASA) Predictors

Independent variables predicted worse MASA raw score during univariate regression analysis (Table 4). In multivariate analysis, a greater number of cranial nerve deficits was the most significant predictor (*P*<0.001, OR 6.0, 95% CI 3.3−11.0). This was followed by cough presence (*P*=0.007, OR=3.4, 95% CI=1.4−8.4), anorexia presence (*P*=0.015, OR=3.3, 95% CI=1.3−8.5) and being in hospice (*P*=0.034, OR=2.9, 95% CI=1.1−7.7). Concordant pairs for the model was 80%, Pearson (Goodness of Fit) was 1.000.

Univariate regression identified the factors that increased dysphagia ordinal risk rating (ORR; Table 5). These were then combined into a multivariate model, where early satiety remained as the only significant predictor of worse dysphagia ORR (*P*=0.013, OR=3.6, 95% CI=1.3−10.0). Concordant pairs was 78.8%, Pearson (Goodness of Fit) was 0.9. Predictors of worse aspiration ORR by univariate analysis are in Table 6. Multivariate analysis was not possible due to the low number of participants with ratings of 'probable' or 'definite' aspiration.

Functional Oral Intake Scale (FOIS) Predictors

Univariate analysis identified predictors of lower FOIS scores. Worse ECOG-PS was most predictive (*P*=0.004, OR=2.0, 95% CI=1.2−3.2), followed by anorexia presence (*P*=0.008, OR=4.2, 95% CI=1.5−12.0), vomiting presence (*P*=0.015, OR=4.2, 95% CI=1.3−13.3), higher OHAT score (*P*=0.025, OR=1.2, 95% CI=1.0−1.5) and denture use (*P*=0.046, OR=2.8, 95% CI=1.0−7.4). Multivariate regression identified that worse ECOG-PS (*P*=0.008, OR=3.7, 95% CI=1.2−12.1) and presence of self-reported vomiting (*P*=0.048, OR=3.4, 95% CI=1.0−11.7) were associated with lower FOIS. Concordant pairs was 63.5%, Pearson (Goodness of Fit) was 0.123.

Discussion

Our study sought to identify dysphagia severity and associate it with pathophysiology. By Mann Assessment of Swallowing Ability (MASA) raw scores, most participants fell into the 'Nil' severity rating for dysphagia and aspiration, with the remainder either mild or moderate. By contrast, ordinal risk ratings (ORRs) found most participants had dysphagia risk, one-third aspiration risk. MASA was developed for stroke disease, so some items (e.g. dysphasia, dyspraxia, dysarthria) were

Table 3
Functional Oral Intake Scale Scores for Dysphagic and Non-Dysphagic Individuals

	Dysphagic		Non-dysphagic[a]	
FOIS	*n*=	%	*n*=	%
7	19/73	26	283/312	91
6	42/73	58	23/312	7
5	11/73	15	4/312	1
4	-	-	2/312	1
3	1/73	1	-	-

[a]FOIS<7 indicates dietary restriction for non-swallow reasons e.g. nausea.

Table 4
Independent Variables Associated with Decreasing Mann Assessment of Swallowing Ability raw Score (Univariate)

Predictor	*P*-value	Level	Odds Ratio	95% CI
ECOG-PS	<0.001	Worse	2.2	1.5−3.4
No. of CN deficits	<0.001	Increasing	6.5	3.7−11.5
Setting	<0.001	Hospice	6.5	2.6−16.7
Team	0.002	Palliative	4.1	1.7−9.9
Age	0.003	Increasing	1.1	1.0−1.1
Location[a]	0.006	IP>DW	4.7	1.6−14.5
No. of comorbidities	0.011	Increasing	1.2	1.0−1.5
Dyspnea	0.013	Present	2.9	1.3−6.6
Cough	0.016	Present	2.8	1.2−6.6
Anorexia	0.020	Present	2.9	1.2−7.3
% Weight loss[b]	0.022	Increasing	1.1	1.0−1.1
OHAT score	0.024	Increasing	1.2	1.0−1.4
EAT-10	0.026	Increasing	1.1	1.0−1.1
Cachexia[b]	0.030	Present	3.4	1.1−10.0
Denture use (OHAT)	0.030	Present	2.6	1.1−6.2
Albumin[b]	0.031	Normal	0.4	0.2−0.9
Receiving targeted therapy	0.032	Present	0.3	0.1−0.9
Early satiety	0.033	Present	2.5	1.1−5.8
Months since diagnosis	0.036	Decreasing	0.98	0.97−1.0
Wheeze	0.042	Present	2.4	1.0−5.5

[a]Day Hospice (DH) and In-Patient (IP) participants were significantly more likely than those in Oncology Day Ward (DW) to have higher dysphagia risk. Since only *n*=6 participants were in DH, results pertaining to this location were unreliable and disregarded.
[b]Analysis conducted using participants for whom data were available (%Weight loss: *n*=46/73; cachexia: *n*=43/73; albumin: *n*=63/73)Non-significant predictors available in supplemental file.

less relevant in our cohort and caused scores to be closer to the normal range. Observed difficulties during swallow trials contributed significantly to ORRs. Most of those with dysphagia had abnormal Functional Oral Intake Scale (FOIS) scores or required a compensatory strategy. This meant MASA raw scores could be near to normal despite observed difficulties. MASA raw scores therefore appear inadequate for identifying dysphagia in this cohort. Instrumental swallow evaluation would be ideal to identify the nature of swallow inefficiencies and more precisely profile aspiration risk. A clinical bedside swallow evaluation more sensitive to the needs of the general cancer population would also be beneficial.

We identified underlying pathophysiological deficits and their association with dysphagia severity. More than half of participants had deficits in swallow-related cranial nerves. Greater number of deficits predicted worse MASA swallow function, and increased likelihood of dysphagia and aspiration. Neuropathy is not uncommon in cancer and may be associated with anticancer treatments.[38] The vagus nerve is particularly susceptible to chronic inflammation[39,40] and was the most-affected here. This nerve mediates cough and some autonomic aspects of digestion,[41,42] which were abnormal and associated with dysphagia. The cranial nerve examination we employed characterized any weak or hoarse voice as impaired. Such qualities can represent age-related changes[43] and may have upwardly biased vagus nerve deficit prevalence.

Oral health was linked with dysphagia. Worse Oral Health Assessment Tool (OHAT) scores predicted worse MASA raw score, higher dysphagia ORR and lower FOIS, but did not affect aspiration risk. Denture use, lingual coating and mucositis were contributory factors to poorer MASA and FOIS, likely because they interfere with preparatory activities like chewing prior to the act of swallowing. Interestingly, xerostomia did not statistically contribute to swallow difficulties despite occurring in two-thirds. Xerostomia can occur without hyposalivation.[44] It may be that participants experienced a sense of difficulty with bolus moistening despite no underlying salivary deficits, but our study did not measure saliva production. Future studies may benefit from discriminating these. Oral health assessment and management should be a priority for clinicians, especially since it diminishes quality of life.[45]

Those with more advanced disease had worse dysphagia. Most prominently, worse ECOG-PS score predicted worse MASA raw score, more likely aspiration and increased diet restriction by FOIS. Other factors that predicted poorer swallow were hospice care, presence of other aerodigestive symptoms (e.g. anorexia, cough, early satiety), more comorbidities, older age and underPC. This supports previous research, which showed that dysphagia manifests when cancer is advanced and especially immediately before death.[46−49] It may be that dysphagia is therefore a sign of overall poorer health, emerges alongside other symptoms and has a potentially multifactorial etiology.

Table 5
Independent Variables Associated with Increasing Mann Assessment of Swallowing Ability Dysphagia Ordinal Risk Ratings (Univariate)

Predictor	*P*-value	Level	Odds Ratio	95% CI
Early satiety	0.001	Present	5.0	2.0−12.5
No. of CN deficits	0.001	Increasing	2.7	1.5−4.8
Anorexia	0.002	Present	4.8	1.8−12.5
OHAT score	0.003	Increasing	1.4	1.1−1.7
Setting	0.007	Hospice	4.2	1.4−11.1
Team	0.016	Palliative	3.2	1.3−8.3
EAT-10	0.020	Increasing	1.1	1.0−1.1
Wheeze	0.025	Present	2.9	1.1−7.1
Age	0.031	Older	1.04	1.0−1.1
Vomiting	0.032	Present	3.8	1.1−12.5
Denture use (OHAT)	0.038	Present	2.8	1.5−4.8
No. of comorbidities	0.041	Increasing	1.2	1.0−1.5
NLR[a]	0.046	High	2.6	1.0−6.7
Dyspnea	0.047	Present	2.4	1.0−5.9
Lingual coating (OHAT)	0.048	Present	2.6	1.0−6.7
Health care provider	0.049	Public	2.5	1.0−6.3
Mucositis (OHAT)	0.049	Present	3.1	1.0−9.1

[a]Analysis conducted using *n*=63/73 participants for whom data were available. NLR: Neutrophil-to-lymphocyte ratio.Non-significant predictors available in supplemental file.

Table 6
Independent Variables Associated with Increasing Mann Assessment of Swallowing Ability Aspiration Ordinal Risk Ratings (Univariate)

Predictor	*P*-value	Level	Odds Ratio	95% CI
No. cranial nerve deficits	<0.001	Increasing	2.9	1.7−5.0
Setting	<0.001	Hospice	7.7	2.6−25.0
Team	0.002	Palliative	5.6	1.9−16.7
ECOG-PS	0.005	Worse	2.1	1. −-3.6
Cough	0.007	Present	6.3	1.7−25.0
BMI[a]	0.020	Increasing	0.8	0.7−1.0
Health care provider	0.039	Public	3.6	1.1−12.5

[a]Analysis conducted using *n*=54/73 participants for whom data were available-Non-significant predictors available in supplemental file.

Hospice and PC services see those with the most severe dysphagia in this population. Those in publicly-funded health care organizations had higher dysphagia and aspiration ORRs than those in private care. The reasons why were not captured, but those who attend public hospitals are older, have riskier lifestyles, and more comorbidities than in private settings.[50] People with better health care access, higher educational attainment and higher income seek help for medical problems more readily.[51] Higher socioeconomic status is also associated with better overall health and lower cancer mortality.[52,53] It may be that those with private health insurance promptly sought and received health care, reducing dysphagia and aspiration risk. Public health care services could consider patient education and routine screening to capture and manage dysphagia.

Strengths and Limitations

This research employed consecutive admissions sampling without seeking to limit itself to any one cancer subpopulation. This was to best represent a typical clinical population and improve ecological validity. However, a large number of people with colorectal, lung, prostate, and renal cancers were sampled due both to disease prevalence and specialist services for these within hospital recruitment settings, which may have biased results. We deliberately used a broad-based diagnostic process to account for problems with either swallow safety or efficiency. Participant-reported difficulties were taken as diagnostic so as not to disregard individuals' experiences. This was important, because the research was novel and the nature and severity of any potential dysphagia previously unknown. The broad-based approach to diagnosis may however have overestimated dysphagia presence if alternative diagnostic criteria are used. Future studies using instrumental evaluation to supplement bedside evaluation would therefore be useful.

Qualitative responses from open-ended case history question facilitated appreciation of features not commonly included in dysphagia checklists and tools, including features uncaptured by MASA. These were unreported here because they provided a rich and sizeable account of patient experiences. These data will be reported separately.

To improve validity and reliability, we used published tools for screening and assessment. This was not without problems, as with MASA, which appeared to represent dysphagia differently by raw scores compared with ORRs. A single investigator carried out all screening and evaluation, which may be a source of bias.

Clinical Implications

Only 12% of our dysphagia cohort had documented swallowing difficulties prior to study enrolment. Services should routinely screen and identify potential dysphagia in cancer populations, regardless of primary tumor site. Hospice and PC services should be particularly vigilant, since increasing dysphagia severity was associated with disease progression and poorer overall health. Cachexia and poor nutrition are significant concerns in cancer.[29] Most of our cohort required diet modification or compensatory swallow strategies. Dysphagia clinicians should work closely with Clinical Nutrition and Dietetics to optimize patients both in terms of nutrition and feeding-related quality of life. This includes promotion of good oral health.

Research Implications

Findings from this research were based on clinical observation and should be verified with instrumental evaluation. Our analysis approach was designed to determine associations with underlying pathophysiology, but cannot identify causality. Other designs like case-control or longitudinal studies may help contextualize the evidence. A replicate study with head, neck and esophageal cancer cohorts would be valuable to identify the extent to which dysphagia is site-specific versus due to cancer *in general* and its treatment.

Conclusions

Dysphagia was prevalent and clinically important in solid tumors outside anatomic swallow regions. Most participants were not known to have swallow difficulties prior to the study, placing them at potential risk. Multimodal evaluation was required to capture the nuanced effects of cancer and anti-tumor treatments on swallow. Individual experiences of difficulties with foods or fluids required bespoke clinical advice, particularly in terms of dietary adjustments and compensatory swallow strategies. Those with more advanced cancer, including people under palliative or hospice care had significantly higher dysphagia and aspiration risks. Careful screening and differential diagnosis by clinicians is essential to ensure that swallow, oral health and nutritional needs are identified and met. Swallow

assessment tools for this clinical population should be a research priority.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jpainsymman.2022.08.019.

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