*Original Article*

# Dysphagia Prevalence and Predictors in Cancers Outside the Head, Neck, and Upper Gastrointestinal Tract

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## Abstract

**Context.** Dysphagia is usually associated with malignancies of the head, neck, and upper gastrointestinal tract but also occurs in those with tumors outside anatomic swallow regions. It can lead to aspiration pneumonia, malnutrition, reduced quality of life, and psychosocial distress. No studies have yet reliably described dysphagia prevalence in those with malignancies outside anatomic swallow regions.

**Objective.** The objective of this study was to establish the prevalence and predictors of dysphagia in adults with solid malignancies outside the head, neck, and upper gastrointestinal tract.

**Methods.** A cross-sectional, observational study using consecutive sampling was conducted. There were 385 participants (mean age 66 ± 12 years) with 21 different primary cancer sites from two acute hospitals and one hospice. Locoregional disease was present in 33%, metastatic in 67%. Dysphagia was screened by empirical questionnaire and confirmed through swallow evaluation. Demographic and clinical predictors were determined by univariate and multivariate binary regression.

**Results.** Dysphagia occurred in 19% of those with malignancies outside anatomic swallow regions. Prevalence was 30% in palliative care and 32% in hospice care. Dysphagia was most strongly associated with cough, nausea, and worse performance status. It was also associated with lower quality of life and nutritional difficulties.

**Conclusion.** Dysphagia was common and usually undiagnosed before study participation. It occurred at all disease stages but coincided with functional decline. It may therefore represent a cancer frailty marker. Oncology and palliative care services should routinely screen for this symptom. Timely dysphagia identification and management may improve patient well-being and prevent adverse effects like aspiration pneumonia and weight loss. J Pain Symptom Manage 2019;58:949–958. © *2019 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.*

***Key Words***

*Cancer, deglutition disorders, dysphagia, hospice and palliative care nursing, neoplasms*

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## Introduction

The International Classification of Diseases (10th Revision) defines dysphagia as "difficulty in swallowing."[1] Swallowing difficulties usually result from destruction or obstruction of bolus transit pathways, local inflammation, or neuromuscular deficits. Diagnosis is established through multimodal swallow assessment, which entails detailed case history, general patient status evaluation (physical and cognitive), cranial nerve examination, observation of ingestion of different food and fluid consistencies, and oral cavity inspection.[2–7]

Dysphagia interferes with mealtimes and may cause anxiety about feeding, increased isolation due to eating alone, and continued hunger or thirst even after mealtimes.[8] It is associated with reduced intake and increased malnutrition risk.[8–13] In cancer, it is associated with caregiver burden,[14–16] depression,[17,18] distress,[19,20] and reduced quality of life.[17,21,22]

Dysphagia increases health care costs and length of stay.[23–26] A systematic review and meta-analysis showed increased cost of 40% and length of stay of three days for hospitalized patients.[27] Aspiration pneumonia is also a potential consequence of this symptom. Both dysphagia[12,23,28] and aspiration pneumonia[29] are associated with higher and earlier mortality.

Because dysphagia may occur through obstruction or destruction of bolus transit pathways, it has usually been associated with malignancies within anatomic swallow regions. As such, it is recognized as an important symptom in head and neck,[30] and upper gastrointestinal (GI)[31] cancers. By contrast, dysphagia in malignancies outside swallow regions has received little attention, despite an established need to generate clinical data for this group.[32] A number of studies have identified dysphagia prevalence in heterogeneous cancer cohorts,[19,28,33–49] with prevalence rates ranging from 7% to 70%. Such varied prevalence rates may be multifactorial.

One factor is the use of imprecise measurement tools. With the exception of one study,[42] none identified dysphagia through confirmatory evaluation and usually relied upon participant self-report. Given the myriad of other nutritional symptoms such as anorexia, nausea, and taste changes experienced in cancer,[36] self-report may be unreliable.

Another factor that may influence prevalence estimation is disease stage. Some studies show that dysphagia is more common and severe toward end of life.[35,41,50] Not only that, but it is an independent prognostic indicator of short-term mortality.[40,50–54] Dysphagia is also reported to be associated with particular primary cancer sites. Those with lung cancer, for example, may develop dysphagia for various reasons including brain metastases, esophageal compression, and vagus nerve compression.[55,56]

No existing studies have precisely described the prevalence or predictors of swallowing difficulties in adults with solid malignancies outside the head, neck, or upper GI tract. Symptom identification and management is an important part of the cancer research agenda for clinicians.[57–60] Those with cancer say that they would like researchers to focus on helping them to maintain their level of independent function and daily activities.[61,62] Swallow screening appears to reduce pneumonia rates and shorten length of stay.[63–65]

This study addresses gaps in dysphagia identification and management by using a comprehensive screening and evaluation protocol in a large and heterogeneous group of individuals with cancer. It aims to profile those most at risk of swallowing difficulties by examining clinical and demographic factors that may influence dysphagia presence. This may lead to more timely intervention and improved patient outcomes.

## Methods

### Recruitment

Using sample size calculation, 385 individuals were recruited to obtain an accurate prevalence. Participants were recruited from two acute hospitals and one hospice by consecutive sampling. They were under medical oncology, radiation oncology, and/or palliative care services and were attending day hospice, inpatients, outpatients, and oncology day ward. Day hospice participants were community-dwelling adults with specialist palliative care needs. Inpatients generally attended for treatment complications or acute symptom management. Outpatients had active disease but were usually under surveillance. Oncology day ward participants were receiving antitumor treatment.

Medical and nursing staff identified eligible participants. Staff members informed patients of the study and asked permission for the researcher to approach them. When approached, the researcher described the study in more detail, provided an information leaflet, and obtained consent. Those eligible but unable to participate (e.g., actively dying) were documented. Ethical approval was granted to capture limited information about these individuals' current diet to reduce sampling bias.

### Inclusion/Exclusion Criteria

Adults (≥18) with a confirmed, active diagnosis of cancer outside the head, neck, or upper GI tract were included (metastases to these sites from other primary tumors were accepted). Participants had to be aware of their diagnosis and able to understand and speak English. Those with nonsolid malignancies were excluded. If referral sources deemed someone inappropriate for study referral, they were excluded.

Exclusion reasons were categorized and documented. Categories were as follows: actively dying, too cognitively impaired, too physically unwell, or too psychologically unwell.

*Clinical and Demographic Information*

Medical and nursing notes were reviewed to determine whether participants had a preexisting dysphagia diagnosis. This was to identify how commonly recognized this symptom was.

Further information from medical documentation included age, cancer treatment(s), comorbidities, disease extent (metastatic or locoregional), height and weight, number and site of distant metastases, primary site, time since diagnosis, and sex. Cancer treatments were categorized as chemotherapy, hormonal therapy, radiotherapy, and/or targeted therapy. Because radiotherapy fields may inadvertently affect swallow structures (e.g., treatment of cervical spine metastases), potential beam exposure to the head, neck, or esophagus was recorded. Participants were documented as under private or public health care services.

*Screening*

All 385 participants were screened by the lead investigator (C. K.). Participants were screened for cognitive deficits and delirium with the 4 A's Test (4AT),[66] where scores >0 indicate impairment. Performance status was measured through participant interview using the Eastern Cooperative Oncology Group Performance Status (ECOG-PS).[67] Both 4AT and ECOG-PS were investigator rated.

Participants were then invited to answer a questionnaire (see Appendices I and II). This identified clinical factors that may be associated with dysphagia. All questionnaire items were participant reported and were as follows.

A global quality of life (QoL) measurement was taken using an adapted scale.[68] Self-reported aerodigestive and nutritional difficulties were marked as present or absent. Terminology to describe these was adapted from the Memorial Symptom Assessment Scale[69] and Patient-Generated Subjective Global Assessment.[70] Upper aerodigestive tract symptoms were as follows: dyspnea, wheeze, dysphonia, and cough. These are highly correlated with dysphagia elsewhere.[71] Nutritional difficulties were as follows: anorexia, early satiety, taste changes, nausea, and vomiting. These were of interest since they may interact with swallowing problems to decrease oral intake.

Dysphagia screening was by EAT-10.[72] Scores ≥3 indicate potential dysphagia and merit full swallow evaluation. Additional questions were added to enhance screening sensitivity. One asked participants whether they had noted any swallowing difficulties. This was adapted from another study,[73] which was found to be a good dysphagia screen.[74] A question about chewing difficulties was added because dysphagia diagnosis includes masticatory difficulties. A third about "being more aware of your swallow" was added in case dysphagia was subclinical. This was intended to capture those whose swallow function was not normal but who were not experiencing overt difficulties. These three questions were anchored to the time frame "since your cancer diagnosis." While those with preexisting dysphagia were included, the use of a time anchor was to identify changes since cancer diagnosis.

Individuals who scored ≥3 on EAT-10 or who answered that they had swallowing or chewing problems had a positive screen and proceeded to swallow evaluation. The question about "being more aware of your swallow" was not a screening criterion because it did not adequately capture the definition of dysphagia.

Finally, participants were asked their current weight, weight six months ago, and height. These were to establish relationships between cachexia, dysphagia, and weight loss. Height and weight information from medical or nursing notes were preferred over participant self-report. Cachexia was diagnosed by the investigator using consensus guidelines.[75]

*Dysphagia Diagnosis*

Dysphagia diagnosis was multimodal and supplemented by structured cranial nerve examination[76,77] and oral health screen using the Oral Health Assessment Tool.[78] The following tasks were used to establish diagnosis.

1. Case history. Participants were asked "Can you tell me about any changes to your eating or drinking habits since you were diagnosed?" and "Are you avoiding any particular foods or drinks since you were diagnosed?." If participants answered "yes" to the latter question, they provided an account of what items were problematic and why.
2. Mann Assessment of Swallowing Ability (MASA).[79] This is a validated bedside swallow evaluation tool, where scores ≤177 indicate dysphagia. MASA also produces risk ratings for both dysphagia and aspiration on an ordinal scale from "unlikely" to "possible", "probable," and "definite." Participants consumed room-temperature still water, purée consistency yoghurt, and a solid cookie. Difficulties consuming these were used to rate items on MASA.
3. Functional Oral Intake Scale (FOIS)[80] score. This describes diet modification requirements, where 7 is an unrestricted and unmodified diet, and scores <7 indicate increasing dietary restriction/modification; an FOIS score of 1 describes a person who is nil-by-mouth and tube fed.

4. Compensatory strategies. Some individuals with dysphagia can maintain a relatively unrestricted diet by using compensatory strategies. For example, dry foods may need to be eaten with sauces or washed down with a fluid to prevent choking.

Based on multimodal evaluation, dysphagia was confirmed if any of the following were true.

1. Concrete swallowing difficulties reported during case history, even if these were not observed during swallow trials (e.g., a history of coughing or choking when eating or drinking)
2. MASA score ≤177, MASA aspiration or dysphagia risk anything other than "unlikely"
3. FOIS score <7
4. Participant needed to use compensatory strategy (either by self-report or observed during swallow trials)

Those eligible but excluded from the study had FOIS scores generated from diet descriptions in medical and nursing notes, and health care staff reports. Scores <7 were considered diagnostic.

*Statistical Analysis*

SPSS 25.0 (IBM Corporation, Armonk, NY) and Minitab 17 (Minitab Inc., State College, PA) were used. All test assumptions were met. For prevalence, descriptive statistics and one-proportion test were used, and figures rounded. Significance for inferential statistics was $\alpha = 0.05$. Binary logistic regression identified dysphagia predictors. Significant associations were initially identified by univariate analysis, then combined into a multivariate model. A saturated model was created. Predictors were removed iteratively, taking the least predictive factor out at each step. $R^2$ adjusted, Akaike information criterion, and goodness of fit were evaluated to determine whether model fit improved with predictor removal, or whether reinsertion into the model was preferred.

Some primary sites were too small in number to determine association with dysphagia presence with any reliability. Only sites represented by at least 20 participants were analyzed. Primary cancers outside these regions were not combined into an "other" category, as this would be clinically meaningless.

## Results

*Participant Characteristics*

Participant demographics and clinical information are summarized in Table 1. The recruitment flowsheet is shown in Fig. 1. Eight individuals had positive dysphagia screens but did not proceed to evaluation. Six of these reported temporary swallowing problems since diagnosis that had resolved. One participant denied a swallowing difficulty but simply disliked pills. One had mouth sores from chemotherapy but denied chewing or swallowing problems.

*Prevalence*

All those evaluated for dysphagia received a confirmed dysphagia diagnosis based on further assessment (Fig. 2, Fig. 3). Prevalence was 73/385 (19%, 95% CI 15–23). Sixty-four of 73 (88%) with dysphagia were undiagnosed before study participation. Prevalence was lower in hospital (16%) than in hospice (32%). Few participants were under radiation oncology, so these were combined with medical oncology to form an "active treatment intent" group. Prevalence in active treatment was 16%, but 30% for those receiving palliative care. Prevalence by primary cancer site is in Table 2.

Of 312 individuals who did not meet positive dysphagia screen criteria, 37/312 (12%) volunteered during screening that they experienced some problems with swallow function but denied having "difficulty swallowing" per the screening tool. Any such comments were systematically documented and compared with the questionnaire item about "being more aware of your swallow." By chi-square analysis, self-reported swallow problems in this group were significantly associated with a positive response to this question ($P < 0.001$, $\chi^2 = 15.533$). A positive response was also associated with a positive dysphagia screen ($P < 0.001$, $\chi^2 = 124.286$).

*Table 1*
**Participant Information**

| Participant Characteristics | $N = 385$ |
|---|---|
| Mean age | 66 (±12) yrs |
| Age range | 37–91 yrs |
| Sex, *n* (%) | |
| Male | 230 (60) |
| Female | 155 (40) |
| Disease extent, *n* (%) | |
| Metastatic | 257 (67) |
| Locoregional | 128 (33) |
| Mean time since diagnosis ($n = 355$) | 21 (±27) months |
| Health care insurance provider, *n* (%) | |
| Public | 169 (44) |
| Private | 203 (53) |
| Unknown | 13 (3) |
| Setting, *n* (%) | |
| Hospice | 74 (19) |
| Hospital | 311 (81) |
| Patient location, *n* (%) | |
| Day hospice | 15 (4) |
| Inpatient | 180 (47) |
| Oncology day ward | 136 (35) |
| Outpatient | 54 (14) |
| Primary health care team, *n* (%) | |
| Medical oncology | 286 (74) |
| Palliative care | 91 (24) |
| Radiation oncology | 8 (2) |

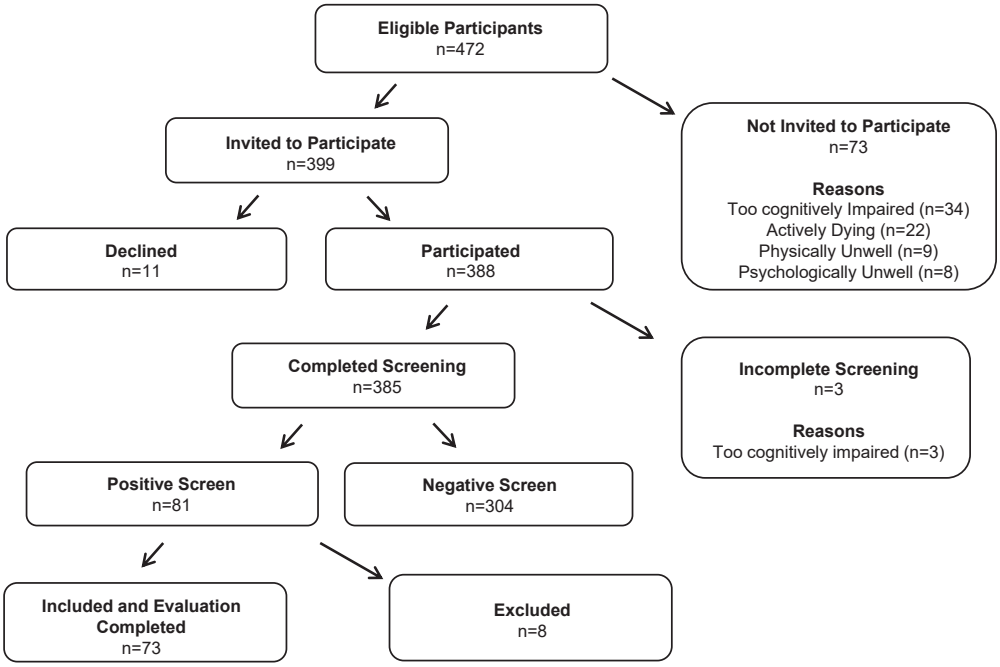


Fig. 1. Recruitment flowchart.

*Predictors*

Dysphagia predictors are summarized in Table 3. Factors that did not reach significance are excluded but available in Appendices I and II. Neither primary site ($P = 0.288$), locoregional versus metastatic disease ($P = 0.635$), greater number of distant metastases ($P = 0.876$), nor time since diagnosis ($P = 0.382$) predicted dysphagia.

By multivariate regression, cough was most predictive of dysphagia ($P = 0.006$, odds ratio 2.4, 95% CI 1.3–4.6). This was followed by nausea ($P = 0.016$, odds ratio 2.2, 95% CI 1.2–4.1). Worse ECOG-PS was also predictive ($P = 0.019$), with worse status indicating increasing likelihood. $R^2$ adjusted for this model was 17.08%, goodness of fit by Hosmer-Lemeshow was 0.105, indicating that the model fits the data well.

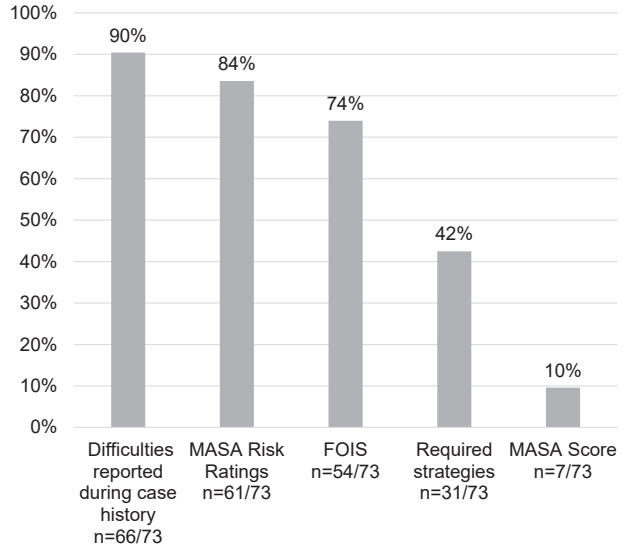


Fig. 2. Dysphagia diagnostic criteria met during evaluation. FOIS = Functional Oral Intake Scale; MASA = Mann Assessment of Swallowing Ability.

*Uninvited and Excluded Individuals*

Fig. 1 shows 73 individuals not invited to participate, and three excluded after recruitment due to cognitive impairment. Data were missing for one uninvited participant. Dysphagia prevalence for these was 43/75 (57%, 95% CI 45–69) using FOIS <7 as a diagnostic criterion. Those actively dying were significantly

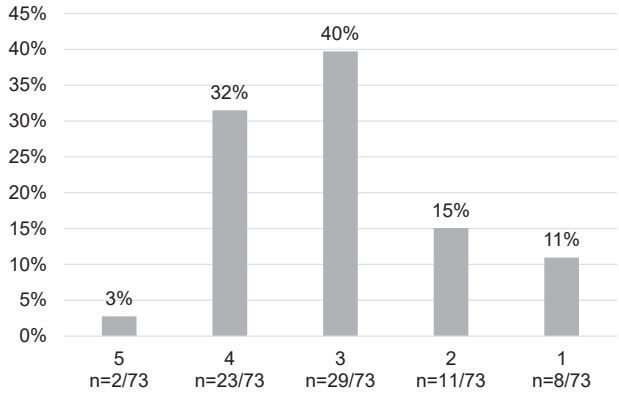


Fig. 3. Number of diagnostic criteria met to merit dysphagia diagnosis.

*Table 2*
**Dysphagia Prevalence by Primary Cancer Site**

| Primary Site | Prevalence in Dysphagia Group | Prevalence by Primary Cancer Site |
|---|---|---|
| Bladder | 3/73 (4%) | 3/39 (8%) |
| Brain | 0/73 (0%) | 0/1 (0%) |
| Breast | 3/73 (4%) | 3/27 (4%) |
| Cervix | 1/73 (1%) | 1/1 (100%) |
| Cholangiocarcinoma | 0/73 (0%) | 0/3 (0%) |
| Colorectal | 18/73 (25%) | 18/82 (22%) |
| Gallbladder | 1/73 (1%) | 1/4 (25%) |
| Kidney | 9/73 (12%) | 9/42 (21%) |
| Liver | 0/73 (0%) | 0/4 (0%) |
| Lung | 15/73 (21%) | 15/59 (25%) |
| Mediastinum | 1/73 (1%) | 1/1 (100%) |
| Melanoma | 1/73 (1%) | 1/8 (13%) |
| Mesothelioma | 3/73 (4%) | 3/3 (100%) |
| Ovary | 1/73 (1%) | 1/20 (5%) |
| Pancreas | 4/73 (6%) | 4/22 (18%) |
| Peritoneal | 0/73 (0%) | 0/1 (0%) |
| Prostate | 10/73 (14%) | 10/53 (19%) |
| Sarcoma | 1/73 (1%) | 1/4 (25%) |
| Testicle | 1/73 (1%) | 1/5 (20%) |
| Thymus | 1/73 (1%) | 1/1 (100%) |
| Uterus | 0/73 (0%) | 0/5 (0%) |

*Table 3*
**Univariate Dysphagia Predictors in Order of Significance**

| Predictor | *P*-value | Level | Odds Ratio (95% CI) |
|---|---|---|---|
| Anorexia | <0.001 | Present | 3.9 (2.2–6.8) |
| Cough | <0.001 | Present | 2.8 (2.1–6.0) |
| Dysphonia | <0.001 | Present | 2.8 (1.6–4.7) |
| ECOG-PS[a] | <0.001 | Worse | — |
| Nausea | <0.001 | Present | 2.9 (1.7–4.8) |
| Taste changes | <0.001 | Present | 2.5 (1.5–4.2) |
| Wheeze | <0.001 | Present | 2.7 (1.6–4.7) |
| No. of comorbidities[b] | 0.001 | Increase | 1.2 (1.1–1.4) |
| Setting | 0.002 | Hospice | 2.6 (1.4–4.6) |
| Quality of life[b] | 0.002 | Worse | 1.1 (1.1–1.3) |
| Dyspnea | 0.003 | Present | 2.2 (1.3–3.7) |
| % Weight loss[b] | 0.003 | Increase | 1.1 (1.0–1.1) |
| Lead health care team | 0.004 | Palliative | 2.3 (1.3–3.9) |
| Patient location[a] | 0.004 | — | — |
| Health care provider | 0.007 | Public | 2.1 (1.2–3.5) |
| HNO radiotherapy[c] | 0.01 | Present | 9.0 (1.6–50.0) |
| Early satiety | 0.015 | Present | 1.9 (1.1–3.2) |
| Cognition | 0.03 | Impaired | 2.5 (1.1–5.4) |
| Cachexia | 0.033 | Present | 2.1 (1.1–4.0) |

ECOG-PS = Eastern Cooperative Oncology Group Performance Status; HNO = radiotherapy affecting the head, neck, or esophagus.
[a]Categorical predictor with multiple levels and odds ratios, therefore not reported for brevity. Full details in Appendices I and II.
[b]Odds ratio per point increase in the direction indicated by level.
[c]Any history of radiotherapy to the head, neck, or esophagus.

more likely to have dysphagia ($P = 0.011$). If data from the 75 excluded/uninvited individuals are combined with those who actively participated, overall dysphagia prevalence was 116/460 (25%).

## *Discussion*

This study captured dysphagia prevalence and predictors in adults with solid malignancies outside the head, neck, and upper GI tract. Overall prevalence was 19%. Hospice and palliative care participants were more likely to have dysphagia. This supports previous findings that dysphagia occurs more frequently toward end of life.[41,50]

The decision to recruit a diverse clinical sample of those with cancer was deliberate. Participant age and gender were representative of a typical cancer population. The sample frame represented a realistic population of patients that might attend a hospital or hospice service. This study showed that dysphagia was not necessarily associated with any particular primary cancer site but that alternative mechanisms may be more broadly responsible for swallowing difficulties.

Importantly, swallowing difficulties in this study were grossly underrecognized before study participation. The reasons for this were not explored. It is noteworthy however that many cancer symptom assessment checklists do not include swallowing difficulties as a potential symptom. Clinicians should therefore ensure that a question about swallow function is part of routine care.

This study used questions about "difficulty swallowing," "difficulty chewing," and the EAT-10 tool to screen for dysphagia. All those with a positive screen went on to receive a confirmed diagnosis, so this approach had excellent sensitivity. There were 37 individuals who did not meet screening criteria, but nevertheless reported some difficulties with swallowing. The screening tool may therefore lack sufficient specificity but is uncertain as these individuals were not evaluated to confirm dysphagia presence or absence. The development of a rigorous dysphagia screen for this population is therefore critical. In the interim, we propose the screening items from this study for clinical use. These are quick to administer, nonburdensome for participants, and based on best available evidence.[74]

### *Disease Progression and Functional Decline*

Dysphagia was not associated with disease progression marked by metastatic changes or time since diagnosis. Instead, it appeared to be linked with functional decline. It was associated with cachexia and increased weight loss. Diagnostically, the frailty syndrome includes progressively poorer physical activity and progressive weight loss.[81] Cognitive impairment is also associated with frailty.[82] Both cachexia and poorer cognition are associated with malnutrition.[83] Multimorbidity is common in frail individuals.[84] These frailty symptoms were all associated with dysphagia. It may therefore be that swallow impairment constitutes a frailty symptom in cancer, as in other populations.[85–87]

Frailty is present in approximately half of those with cancer.[88] Because it is associated with multiple risk factors and symptoms, it can occur any time in the disease. This may be why disease progression was

insignificant. Instead, frailty symptoms and poorer performance status predicted dysphagia. Clinicians should therefore screen for dysphagia in those receiving curative treatments, not just palliative care, as frailty may be present along the disease trajectory.

*Aerodigestive and Nutritional Difficulties*

Dysphagia was predicted by other aerodigestive symptoms by univariate analysis. This relationship was previously reported,[71] but this study corroborates this relationship using confirmed dysphagia diagnosis, rather than relying on participant self-report. The underlying mechanisms that explain co-occurrence of dysphagia and these other symptoms remain unknown and merit exploration.

Swallowing difficulties were also predicted by nutritional barriers. Previous work showed dysphagia was associated with vomiting.[43] This relationship was marginally beyond significance here. Anorexia and taste changes clustered with dysphagia in another study,[89] similar to our findings. Given that dysphagia commonly co-occurs with other nutritional problems, this reinforces the need to explicitly identify whether reduced intake is due to swallowing or other difficulties. This would help to ensure timely referral for swallow and dietary management with relevant health care professionals.

*Other Predictors*

Dysphagia was associated with state-provided health care. The reasons for this were unclear, but a review of European hospital services showed those attending public hospitals tended to be older, have riskier lifestyles, more comorbidities, and more complications than in private settings.[90]

Lower quality of life was associated with swallowing problems. A swallow-related QoL measure was not used, so a causal link cannot be established. Future research could include the use of a tool like the SWAL-QoL,[91] which was designed for this purpose. This was not used in the present study, as the time to administer is 14 minutes and this would have been too burdensome for participants.

*Strengths and Limitations*

This study had a large and diverse, improving generalizability to other contexts. It was prospective and multisite. Participants under public and private health care services were included. They had locoregional and metastatic disease, a representative age and gender profile, and varied primary cancer sites. Those from diagnosis to end of life were included. As such, it represents a clinically realistic patient profile. Clinicians should however remember that prevalence rates provided for individual primary cancer sites are limited by group size. This is especially true where primary cancer sites were represented by very small numbers of individuals (e.g., mesothelioma, thymus).

Fewer individuals were recruited from radiation oncology teams than expected. Only one study site provided this service. In that setting, patients were often enrolled in other studies and usually attended as day cases, so participation would have increased hospital length of stay, which may have discouraged patients. This limited generalizability to those under radiation oncology services.

The use of a reference standard examination of swallowing (such as videofluoroscopic swallow studies) would have been beneficial to support diagnosis of dysphagia and aspiration in this study. As a large epidemiological study, however, this would have been prohibitively expensive and time consuming and was therefore not pursued.

*Future Directions*

This study aimed to identify dysphagia prevalence and predictors. Detailed outcomes of swallow evaluations will be reported separately in a future publication.

The pathophysiology of dysphagia in the cohort of interest remains unknown, but frailty and functional decline has been suggested as one potential cause. In elderly populations, "sarcopenic dysphagia" occurs through depleted muscle mass.[92] It may be that a "cachectic dysphagia" was present in this group, perhaps in addition to sarcopenia. Future studies could consider controlling for nutritional intake in more detail. It may be the case that the relationship between weight loss and dysphagia is cyclical. Depleted muscle mass through cachexia may lead to poorer swallowing function, leading to even more loss of skeletal muscle.

This study identified the risk factors most likely to be associated with dysphagia in adults with solid malignancies outside the head, neck, and upper GI tract. Researchers and clinicians may now more readily identify who has this symptom and approach such patients directly. This means reduced resource costs in terms of resource allocation. For research, one implication is that studies using instrumental evaluation of swallowing are more affordable. Functional swallow examinations like barium swallow, fiberoptic endoscopic evaluation of swallowing, high-resolution manometry, and videofluoroscopic swallow studies would be beneficial for providing more objective and detailed measurement in those most likely to have dysphagia.

## Conclusions

This study was the first to show that dysphagia occurs frequently in those with tumors that are outside anatomical swallow regions. It occurs throughout the cancer trajectory, and not simply at end of life. Those with cough, nausea, and poorer performance status

were most likely to have dysphagia, but it was also significantly associated with cachexia and weight loss, placing patients at further nutritional risk.

Dysphagia was most common in hospice and palliative care. It was associated with frailty and functional decline. Dysphagia was usually undiagnosed before study participation, meaning that it was likely to be inadequately managed. Both oncology and palliative care services should routinely screen swallow function and refer patients for nutritional and swallow assessment if concerned. Implementation of such routine screening could lead to more timely and effective management. This may improve patient health and well-being.

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Ethical approval: Ethical approval was obtained from St. James's Hospital/Tallaght University Hospital Joint Research Ethics Committee (2017-05, Chairman's Action 3; May 18, 2017). It was obtained from Beacon Hospital Research Ethics Committee (BEA0079; July 3, 2017). It was provided by Our Lady's Hospice & Care Services Education and Research Committee (May 29, 2017). Written informed consent was obtained from participants.

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## *Appendix I: Participant Questionnaire*

Quality of Life

How would you describe your overall quality of life during the past week including today? Please circle the number (0–10).

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| As bad as it can be | | | | | | | | | | As good as it can be |

During the past week did you have any of the following symptoms?

| | Yes | No |
|---|---|---|
| 1. Shortness of breath | | |
| 2. Wheeze | | |
| 3. Hoarse voice | | |
| 4. Cough | | |
| 5. Lack of appetite | | |
| 6. Feeling full quickly | | |
| 7. Change in the way food tastes | | |
| 8. Nausea | | |
| 9. Vomiting | | |

Since your cancer diagnosis have you noticed any of the following?

| | | Yes | No |
|---|---|---|---|
| 1 | Difficulty swallowing | | |
| 2 | Difficulty chewing | | |
| 3 | Being more aware of your swallow | | |

Please circle a number (0 = no problem, 4 = severe problem)

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | My swallowing problem has caused me to lose weight | 0 | 1 | 2 | 3 | 4 |
| 2. | My swallowing problem interferes with my ability to go out for meals | 0 | 1 | 2 | 3 | 4 |
| 3. | Swallowing liquids takes extra effort | 0 | 1 | 2 | 3 | 4 |
| 4. | Swallowing solids takes extra effort | 0 | 1 | 2 | 3 | 4 |
| 5. | Swallowing pills takes extra effort | 0 | 1 | 2 | 3 | 4 |
| 6. | Swallowing is painful | 0 | 1 | 2 | 3 | 4 |
| 7. | The pleasure of eating is affected by my swallowing | 0 | 1 | 2 | 3 | 4 |
| 8. | When I swallow food sticks in my throat | 0 | 1 | 2 | 3 | 4 |
| 9. | I cough when I eat | 0 | 1 | 2 | 3 | 4 |
| 10. | Swallowing is stressful | 0 | 1 | 2 | 3 | 4 |

What was your weight six months ago? _____

What is your current weight? _____

What height are you? _____

# *Appendix II*

## Nonsignificant predictors of dysphagia presence

| Predictor | *P*-value |
|---|---|
| Current HNO radiotherapy[a] | — |
| Vomiting | 0.057 |
| Current chemotherapy | 0.065 |
| Any history of other radiotherapy | 0.162 |
| Current targeted therapy | 0.2 |
| Body mass index | 0.202 |
| Primary site | 0.288 |
| Current other radiotherapy | 0.355 |
| Time since diagnosis (months) | 0.382 |
| Any history of chemotherapy | 0.384 |
| Current hormonal therapy | 0.437 |
| Any history of targeted therapy | 0.439 |
| Sex | 0.525 |
| Time since diagnosis (yrs) | 0.622 |
| Disease extent | 0.635 |
| Age | 0.821 |
| Number of distant metastases | 0.876 |
| Any history of hormonal therapy | 0.952 |

HNO = radiotherapy affecting the head, neck, or esophagus.
[a]Insufficient sample size to examine.

## Odds ratios for dysphagia presence by Eastern Cooperative Oncology Group Performance Status score

| | 0 (95% CI) | 1 (95% CI) | 2 (95% CI) | 3 (95% CI) |
|---|---|---|---|---|
| Reference | | | | |
| 1 | 2.2 (0.8–6.0) | — | — | — |
| 2 | 7.3 (2.6–20.6) | 3.3 (1.7–6.3) | — | — |
| 3 | 4.6 (1.5–13.8) | 2.1 (1.0–4.4) | 0.6 (0.3–1.4) | — |
| 4 | 11.2 (2.5–49.8) | 5.0 (1.4–17.7) | 1.5 (0.4–5.5) | 2.4 (0.6–9.3) |

## Odds ratios for dysphagia by patient location

| | DW (95% CI) | IP (95% CI) | OP (95% CI) |
|---|---|---|---|
| Reference | | | |
| DH | 5.0 (1.7–10.0) | 2.5 (0.8–10.0) | 2.5 (0.7–10.0) |
| IP | 2.6 (1.3–4.9) | — | — |
| OP | 2.5 (1.1–5.8) | 1 (0.5–2.0) | — |

DH = day hospice; DW = oncology day ward; IP = inpatient; OP = outpatient.