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# Oropharyngeal dysphagia as a risk factor for malnutrition and lower respiratory tract infection in independently living older persons: a population-based prospective study

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## Abstract

**Objective:** to assess the role of oropharyngeal dysphagia (OD) as a risk factor for malnutrition and/or lower respiratory tract infection (LRTI) in the independently-living population of 70 years and over.
**Design:** a population-based cohort study.
**Subjects and setting:** persons 70 years and over in the community (non-institutionalised) were randomly selected from primary care databases.
**Measurements:** the volume-viscosity swallow test (V-VST) was administered by trained physicians at baseline to identify subjects with clinical signs of OD and impaired safety or efficacy of swallow. At the one year follow-up visit, hand grip, functional capacity (Barthel score), nutritional status (mini nutritional assessment, MNA) and LRTI (clinical notes) were assessed.
**Results:** two hundred and fifty-four subjects were recruited (46.5% female; mean age, 78 years) and 90% of them (227) were re-evaluated one year later. Annual incidence of 'malnutrition or at risk of malnutrition' (MNA <23.5) was 18.6% in those with basal signs of OD and 12.3% in those without basal signs of OD ($P = 0.296$). However, prevalent cases of 'malnutrition or at risk of malnutrition' at follow up were associated with basal OD (OR = 2.72; $P = 0.010$), as well as with basal signs of impaired efficacy of swallow (OR = 2.73; $P = 0.015$). Otherwise, LRTI's annual incidence was higher in subjects with basal signs of impaired safety of swallow in comparison with subjects without such signs (40.0 versus 21.8%; $P = 0.030$; OR = 2.39).

**Conclusions:** OD is a risk factor for malnutrition and LRTI in independently living older subjects. These results suggest that older persons should be routinely screened and treated for OD to avoid nutritional and respiratory complications.

**Keywords:** *dysphagia, nutritional status, lower respiratory tract infection, functional capacity, elderly*

## Introduction

Oropharyngeal dysphagia (OD) is a highly prevalent clinical condition among elderly persons whether institutionalised [1] or living in the community [2, 3]. It can be easily and accurately detected by trained health care professionals using the volume-viscosity swallow test (V-VST). This test allows signs of impaired efficacy to be distinguished from signs of impaired safety of swallow [4], which may be of clinical interest when evaluating nutritional and respiratory risks associated with OD. There is indirect evidence that alterations in the efficacy of swallow cause malnutrition and dehydration, and that impaired safety of swallow produces aspiration to the respiratory tract with high risk of developing lower respiratory tract infections (LRTIs) and pneumonia [5, 6]. A high prevalence of OD has been described in elderly patients with pneumonia [7] as well as increased aspiration pneumonia rates in nursing home residents with dysphagia [8]. However, there is little conclusive evidence from prospective studies on the causal relationship between OD and malnutrition and between OD and LRTI-community-acquired pneumonia (CAP). Despite malnutrition and LRTI-CAP being recognised as complications of OD, few prospective studies have been published on this topic on the independently living elderly population. The aim of the present study was to determine whether OD increased the risk of developing malnutrition and/or LRTI-CAP in the 70-year-old or over population living in the community.

## Methodology

### Design and study population

A population-based cohort study with 1-year follow-up was designed. Persons 70 years old and over were randomly selected from the *Cirera-Molins* Primary Care Centre database (Mataró, Barcelona, Spain). Random sampling was stratified by sex and age groups (70–79 and ≥80 years old). Accepting an alpha risk of 0.05 and a beta risk of 0.2 in a one-sided test, assuming 25% prevalence of OD in the study population, and anticipating a 10% drop-out rate, 50 subjects with OD and 203 without OD (253 subjects in total) were necessary for a difference greater than or equal to 20% in the annual incidence of LRTI to be recognised as statistically significant (a 30% annual rate was estimated in the group with OD). A letter was sent to pre-selected subjects, inviting them to participate in the study, and a week later a telephone call was made to arrange a visit at the primary care centre. If, after four attempts, contact could not be made or the selected person refused to participate, they were substituted by another of the same age and sex following the same random sampling procedure. Institutionalised persons or those in palliative care or with a life expectancy of less than 3 months were excluded. No subject was excluded because of cognitive impairment. One year later all participants were called again to plan a control visit to assess main outcome measures (risk of malnutrition and LRTI-CAP). Death or other withdrawal reasons were registered when planning the follow-up appointment. The study protocol was approved by the ethical committee of the *Consorci Sanitari del Maresme* (CSdM) and all subjects or their legal representatives signed an informed consent form before inclusion.

### Measurements

At baseline, clinical assessment of dysphagia by V-VST was conducted by trained GPs (all them attended a 1-h training session). This test assesses different signs of efficacy and safety of deglutition with boluses of increasing volume (5, 10 and 20 ml) at nectar (270 mPa/s), liquid (20 mPa/s) and pudding (3900 mPa/s) viscosities [4]. Clinical signs of impaired efficacy of swallow (IES) are impaired labial seal, oral or pharyngeal residue and piecemeal deglutition (multiple swallows per bolus). Clinical signs of impaired safety of swallow (ISS) are changes in voice quality (including wet voice), cough or a decrease in oxygen saturation of 3% or more, measured with a finger pulse-oximeter. The V-VST is an effort test designed to protect patients from aspiration. When patients complete the nectar series without symptoms of aspiration, a less safe, liquid viscosity series is assessed and finally a safer pudding viscosity series is assessed. If the patient presents signs of impaired safety, the series is interrupted. The V-VST is considered positive for OD if any of the mentioned signs of impaired efficacy or safety is identified in any bolus. In the same way, the test is considered positive for IES with the presence of any efficacy signs in any bolus and the same for safety of swallow. The V-VST is a validated method with good diagnostic accuracy when compared with a videofluoroscopy, which takes less than 10 min to be performed [4]. Other study variables considered were socio-demographic variables including age, sex, education and family support; toxic habits; co-morbidities; physical exploration including weight, height, waist circumference and hand grip strength measured with a hand held dynamometer; functional capacity according to the Barthel test and nutritional status with the

mini nutritional assessment (MNA). Frail condition was established according to Fried criteria [9], when a person fulfilled three or more of the following five criteria: non-intentional weight loss (>4 kg or 5% of usual weight) or BMI less than 19, self-reported exhaustion (usual energy <3 in VAS), poor muscle strength (<20th percentile: <7 kg in women and <14 kg in men), slow walking speed (≥7 seconds to walk 4.5 m) and poor physical activity (no outdoor life or <0.5 h of outdoor walking a day). A follow-up visit was carried out 1-year later and physical examination, hand grip, functional capacity, frailty, nutritional status and quality of life were re-evaluated in the same way. Information about the occurrence of LRTI and/or CAP during the follow-up period was obtained by reviewing the electronic clinical notes in the primary care setting and in the hospital of Mataró, where physicians register all clinical events, visits, tests and treatments. These diagnoses were done by physicians according to the clinical practice guidelines of the institution on this topic that indicates a chest X-ray for confirming a CAP.

### Statistical analysis

The MNA was categorised with a cut-off at 23.5 points; MNA >23.5 was considered well nourished and MNA ≤23.5 malnourished or at risk of malnutrition (M/RM). Main outcome measurements considered were number of well nourished cases at baseline visit that develop M/RM during follow-up (incidence cases), total number of cases with M/RM at follow-up visit (prevalent cases) and incidence cases of LRTI and/or CAP (new episodes during follow-up). To assess whether basal OD, IES or ISS was related with nutritional status, LRTI-CAP or other categorical variables at follow–up; the Chi-square test or Fisher's exact test was used. Student's *t*-test or the Mann–Whitney *U* test was used to compare quantitative variables such as weight, Barthel score and overall quality of life between subjects with and without swallow impairments. As a measure of association between these swallow impairments and main outcome measurements, crude and adjusted (by possible confounders) odds ratios (OR) and their 95% CI were estimated using logistic regression. The effect of IES on M/RM at follow-up was adjusted by age, functional capacity and M/RM at baseline, and the effect of ISS on LRTI was adjusted by age, functional capacity and chronic bronchitis or chronic obstructive pulmonary disease (COPD). A *P*-value less than 0.05 was considered statistically significant.

## Results

Six hundred and thirty-three persons were pre-selected from the primary care database. Of these, 253 were rejected because (i) 41 had died, (ii) 42 were not located, (iii) 86 had moved and (iv) 84 were institutionalised and therefore excluded. Of the remaining 380 persons, 126 (33.1%) refused to participate and 254 (66.8%) were included in the study. The main reason for refusing to participate, declared by pre-selected subjects or their caregivers, were (i) severe frailty or physical impairment in 30 cases, (ii) concomitant acute diseases in 29 cases, (iii) severe dementia in six cases, (iv) social reasons in six cases and (v) not wishing to participate in 55 cases. Of the 254 persons recruited, mean age was 78.2 (5.6) years, 136 were men (53.5%) and 118 were women (46.5%). Most of the sample had an outdoor life and good functional capacity. Frailty was found in 18%, with a higher prevalence among women. Table 1 compares main basal characteristics, co-morbidities, treatments and nutritional and functional status between patients with and without OD. At baseline, subjects with OD were older, had worse functional capacity and a higher prevalence of depression and use of sedatives. Prevalence of signs of OD,

Table 1. Comparison of main basal characteristics between subjects with and without oropharingeal dysphagia (OD)

| | Non-OD, *n* = 185 | OD, *n* = 69 | *P*-value |
|---|---|---|---|
| Socio-demographic data | | | |
| Age (years) | 77.4 (5.0) | 80.3 (6.4) | <0.001 |
| Sex (% female) | 84 (45.4) | 34 (49.3) | 0.582 |
| Living alone (%) | 39 (21.1) | 13 (18.8) | 0.694 |
| Toxic habits and life style | | | |
| Present smoking (%) | 14 (7.6) | 3 (4.3) | 0.572 |
| Regular alcohol drinkers (%) | 62 (53.4) | 23 (51.1) | 0.790 |
| Outdoor life (%) | 174 (94.1) | 65 (94.2) | 1.000 |
| Hours walking outdoors/day | 1.7 (1.1) | 1.7 (1.4) | 0.680 |
| Co-morbidities (%) | | | |
| Heart disease | 36 (19.5) | 16 (23.5) | 0.478 |
| Stroke | 8 (4.3) | 7 (10.3) | 0.128 |
| Parkinson disease | 1 (0.5) | 2 (2.9) | 0.177 |
| Dementia | 3 (1.6) | 4 (6.0) | 0.083 |
| Depression | 27 (14.6) | 17 (25.4) | 0.046 |
| Active cancer | 23 (12.5) | 6 (9.0) | 0.437 |
| Chronic bronchitis/COPD | 39 (21.1) | 16 (23.9) | 0.635 |
| Asthma | 13 (7.0) | 6 (9.0) | 0.609 |
| Diabetes | 46 (24.9) | 15 (22.7) | 0.728 |
| Cholelitiasis | 32 (17.3) | 6 (8.8) | 0.094 |
| Gastro-duodenal ulcer | 23 (12.4) | 11 (16.7) | 0.388 |
| Gastroesophageal reflux | 19 (10.3) | 13 (19.1) | 0.061 |
| Chronic liver disease | 14 (7.7) | 2 (3.1) | 0.253 |
| Treatment with … (%) | | | |
| Benzodiazepines | 36 (19.5) | 21 (31.3) | 0.046 |
| Antipsychotic drugs | 6 (3.2) | 4 (6.1) | 0.296 |
| Omeprazole, anti-H2 or anti-acids | 89 (48.1) | 41 (59.4) | 0.109 |
| NSAI | 43 (23.5) | 20 (29.0) | 0.370 |
| Physical examination | | | |
| Weight | 72.5 (12.8) | 70.9 (13.4) | 0.389 |
| Hand grip in the non-dominant hand (kg) | | | |
| Men | 18.4 (6.0) | 14.6 (7.1) | 0.009 |
| Women | 7.3 (3.9) | 6.8 (3.4) | 0.752 |
| Walking speed (seconds to walk 4.5 m) | 5.2 (2.2) | 5.9 (2.8) | 0.044 |
| Barthel score (optimal = 100) (%) | 158 (85.4) | 40 (58.0) | <0.001 |
| Self reported fatigue (%) | | | |
| None | 84 (45.4) | 22 (31.9) | |
| A little | 64 (34.6) | 28 (40.6) | 0.116 |
| Quite a lot | 26 (14.1) | 10 (14.5) | |
| A lot | 11 (5.9) | 9 (13.0) | |
| Risk of malnutrition (sf-MNA ≤23.5) | 23 (12.4) | 15 (21.7) | 0.064 |
| Frailty | 29 (15.7) | 18 (26.1) | 0.057 |

**Table 2.** Effect of basal oropharyngeal dysphagia, impaired efficacy of swallow and impaired safety of swallow on main outcome measures at 1-year follow-up

| | OD | Non-OD | *P*-value | OR (95% CI) |
|---|---|---|---|---|
| Effects on nutritional parameters | | | | |
| Annual incidence of M/RM (%) | 18.6 | 12.3 | 0.211 | 1.63 (0.65–4.09) |
| Prevalence of M/RM at follow-up (%) | 26.0 | 11.4 | 0.010 | 2.72 (1.25–5.95) |
| Weight loss >5% | 14.3 | 11.1 | 0.336 | 1.33 (0.55–3.24) |
| | IES | Non-IES | *P*-value | OR (95% CI) |
| Annual incidence of M/RM (%) | 16.7 | 13.2 | 0.401 | 1.31 (0.45–3.24) |
| Prevalence of M/RM at follow-up (%) | 27.5 | 12.0 | 0.015 | 2.73 (1.19–6.26) |
| Weight loss >5% (%) | 14.3 | 11.4 | 0.380 | 1.30 (0.49–3.46) |
| | OD | Non-OD | *P*-value | OR (95% CI) |
| Effects on respiratory complications | | | | |
| Annual incidence of LRTI (%) | 26.8 | 23.4 | 0.607 | 1.20 (0.60–2.39) |
| Annual incidence of CAP (%) | 1.8 | 1.8 | 0.732 | 0.98 (0.10–9.58) |
| | ISS | Non-ISS | *P*-value | OR (95% CI) |
| Annual incidence of LRTI (%) | 40.0 | 21.8 | 0.030 | 2.39 (1.07–5.34) |
| Annual incidence of CAP (%) | 0 | 2.1 | 0.554 | 0 |

OD, oropharyngeal dysphagia; IES, impaired efficacy of swallow; M/RM, malnutrition or 'at risk' of malnutrition (MNA ≤23.5). LRTI, lower respiratory tract infection. CAP, community-acquired pneumonia. ISS, impaired safety of swallow.

**Table 3.** Adjusted effects of impaired efficacy and safety of swallow on nutritional status and lower respiratory tract infection, respectively

| | OR (95% CI) | *P*-value |
|---|---|---|
| Malnutrition or at risk of malnutrition at follow-up | | |
| Impaired efficacy of swallow (IES) | 2.31 (0.96–5.57) | 0.062 |
| Age | 1.03 (0.96–1.10) | 0.448 |
| Barthel score | 0.99 (0.95–1.02) | 0.443 |
| Malnutrition or at risk of malnutrition at baseline | 0.70 (0.26–1.89) | 0.481 |
| Lower respiratory tract infection during follow-up | | |
| Impaired safety of swallow (ISS) | 2.55 (1.07–6.09) | 0.035 |
| Age | 1.02 (0.96–1.08) | 0.633 |
| Barthel score | 1.01 (0.96–1.06) | 0.724 |
| Chronic bronchitis/COPD | 4.05 (2.03–8.08) | <0.001 |

IES and ISS at basal time has been previously published [3]. Two hundred and twenty-seven subjects out of the initial 254 (89.4%) were followed up 1 year later. Twenty seven subjects dropped out, 5 had died, 4 had moved or were not located and 18 did not wish to participate.

Table 2 shows the effect of basal OD, IES and ISS on nutritional status and respiratory complications at follow-up. Annual incidence of M/RM was higher in those with basal signs of OD in comparison with those without basal signs of OD, although theses differences were not statistically significant. However, prevalent cases of M/RM at follow-up were associated with basal OD (OR = 2.72; $P = 0.010$), as well as with basal signs of IES (OR = 2.73; $P = 0.015$). When adjusting this effect by age, Barthel score and basal nutritional status, IES presented an OR = 2.31 ($P = 0.062$) (Table 3). Table 2 also presents the results of the relationship of OD and ISS with respiratory infections. Patients with ISS had twice the risk of LRTI than patients without this impairment, a significant effect that persisted when adjusted for age, Barthel score and chronic bronchitis/COPD (see Table 3). Regarding functional capacity, no statistically significant differences were observed between OD and non-OD subjects in annual incidence of frailty. However, 14.3% of subjects with OD lost more than 10 points in Barthel score at follow-up compared with 2.3% in subjects without OD (OR = 6.96, 95% CI: 2.01–24.1, $P = 0.002$). Moreover, 61.3% of men with OD had lost more than 5% of their initial hand grip strength at follow-up compared with 40.4% in men without OD (OR = 2.33, 95% CI: 1.02–5.36, $P = 0.043$). This muscle strength decline was not observed in women the hand grip of whom was clearly inferior to men's. Finally, no significant differences in mortality rate was observed between OD and non-OD persons (2.9 versus 1.6%, respectively, $P = 0.413$).

## Discussion

This prospective study shows that IES is a risk factor for M/RM, ISS is a risk factor for LRTI and OD as a whole is a risk factor for loss of functional capacity in independently living persons 70 years old or over. These results indicate that a large number of elderly people in the community are at risk of nutritional and respiratory complications due to swallow disorders that are usually under-diagnosed and under-treated. Physicians do not systematically explore deglutition in malnourished elderly patients or aged patients with pneumonia, while easy and validated screening instruments exist, as well as effective measures that may protect them from these adverse events [10, 11].

Although malnutrition is recognised as a complication of dysphagia in older persons, there are few original studies reporting this relationship. Studies tend to consider only specific populations such as patients with stroke, Parkinson disease and multiple sclerosis or nursing home residents. Most of these studies have a cross-sectional design and their results are not always concordant and conclusive. In a cross-sectional study, Suominen *et al.* reported a strong and significant relationship between malnutrition and difficulties in swallowing (OR = 3.03) in Finnish nursing home residents [12]. With the same design, Nozaki *et al.* found a 31% prevalence of dysphagia among Parkinson patients and reported significantly lower BMI and biochemical nutritional parameters in the dysphagic group in comparison with the non-dysphagic group [13], while Coates and Bakheit found that nutritional status of patients with Parkinson disease, with 81% prevalence of swallowing difficulties, was similar to that of age- and sex-matched control subjects [14]. Thomas and Wiles reported a 43% prevalence of dysphagia in patients with multiple sclerosis but did not find any association between abnormal swallow and nutritional indices in these

patients [15]. More evidence has been published in patients with stroke. Smithard *et al.* prospectively studied 121 consecutive patients with acute stroke and reported a poorer nutritional state in those patients with dysphagia [16] and a review that summarised eight published trials that had examined both the swallowing ability and nutritional status of patients with stroke showed that dysphagic patients had an increased risk of being malnourished with an OR of 2.4 [17]. The present study has prospectively assessed nutritional status in a cohort of elderly subjects and has found statistically significant differences in the prevalence of M/RM at follow-up between persons with and without OD. However, differences in the incidence of M/RM, that is, the new cases of nutritional deterioration, were not statistically significant, possibly because the follow-up period was too short to allow malnutrition appearance. Subjects with OD recruited in the present study suffered that this swallow impairment before the beginning of the study, so considering prevalent cases of M/RM at follow-up, which include new cases as well as baseline cases, is also worthwhile and may reflect the previous cumulated effect of OD. Moreover, when adjusting the effect of IES by baseline M/RM and other possible confounders, the effect is maintained with an OR = 2.31, with a $P = 0.062$ suggesting a lack of statistical power. Other studies reported that, in patients with stroke, treatment with swallowing techniques improved swallowing function and nutritional status [11], which further reinforces the causal relationship between dysphagia and malnutrition.

Likewise, there is increasing evidence of the critical role of dysphagia and aspiration in the development of respiratory infections in the elderly population. Dysphagia is a highly prevalent (55%) clinical finding in elderly patients with pneumonia and determines its severity [7, 18]. Frail elderly persons have high prevalence of mouth colonisation by Gram-negative bacilli associated with increased rates of LRTIs [19], and eradication of oral carriage in this population has shown a significant reduction in pneumonia rates [20, 21]. Other authors have reported that nearly half nursing home residents with dysphagia developed aspiration pneumonia in 1 year, with 45% mortality [8]. The Centre for Disease Control and Prevention (CDC) recognises that oropharyngeal aspiration is an important aetiological cause of nosocomial pneumonia [22]. Although most of the above-mentioned studies have used institutionalised populations, the effect of OD on respiratory infections could be similar in older persons independently of whether their residence is at home or in long-term care facilities. The present study on the independently living elderly population has shown a prospective relationship between ISS and LRTI, both in the univariate analysis and when adjusted for possible confounders, with an OR close to 2.5. No statistical association has been observed between swallow impairments and CAP probably because of the relatively small incidence of this complication, the small sample size and the shortness of the follow-up period.

The present study also shows that elderly subjects with swallow impairments had a higher risk of suffering functional decline with respect to those elderly subjects without OD and, in men but not in women, OD was also a risk factor for a significant decline in muscle strength. Other studies have reported the close relationship between dysphagia and functional capacity in the elderly [7]. Dysphagia contributes to malnutrition and malnutrition contributes to deterioration of functional capacity and muscle debilitation which, in turn, can favour dysphagia, causing a vicious circle and suggesting that dysphagia could be one of the initiating/trigger factors of the frailty process. On the other hand, in the baseline cross-sectional analysis, a significant association of OD with depression and treatment with benzodiazepines has been shown. It could be related with the mio-relaxing effect of benzodiazepines, but further research is needed to confirm this hypothesis.

In conclusion, in the independently living aged population, signs of OD and IES must warn about an increased risk of malnutrition, signs of ISS about increased the risk of developing LRTI and signs of OD about significant functional decline. These results suggest OD should be considered a geriatric syndrome and routinely screened, diagnosed and treated in aged populations to avoid respiratory complications, nutritional deterioration and functional decline.

## Key points

- Clinical signs of OD can be easily detected at primary care setting.
- Older people with clinical signs of OD have higher risk for LRTIs, nutritional deterioration and functional decline.
- Older persons should be routinely screened and treated for orophayingeal dysphagia.

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## Conflict of interest

None declared.

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# The prediction of functional decline in older hospitalised patients

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