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# PERCUTANEOUS ENDOSCOPIC GASTROSTOMY VERSUS NASOGASTRIC FEEDING IN OLDER INDIVIDUALS WITH NON-STROKE DYSPHAGIA: A SYSTEMATIC REVIEW

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**Abstract:** *Objective:* The objective of this systematic review was to evaluate existing studies on the effectiveness of percutaneous endoscopic gastrostomy (PEG) feeding compared to nasogastric (NG) feeding for patients with non-stroke related dysphagia. *Methods:* We searched Ovid MEDLINE, EMBASE, the Cochrane Library, Web of Science and PubMed databases through to December 2013 using the terms «percutaneous endoscopic gastrostomy», «gastrostomy», «PEG», «nasogastric», «nasogastric tube», «nasogastric feeding» and «intubation». We included randomized controlled trials (RCTs) and non-RCTs which compared PEG with NG feeding in individuals with non-stroke dysphagia. *Results:* 9 studies involving 847 participants were included in the final analysis, including two randomized trials. Pooled analysis indicated no significant difference in the risk of pneumonia [relative risk (RR) = 1.18, 95% confidence interval (CI) = 0.87-1.60] and overall complications [relative risk (RR) = 0.80, 95% confidence interval (CI) = 0.63-1.02] between PEG and NG feeding. A meta-analysis was not possible for mortality and nutritional outcomes, but three studies suggested improved mortality outcomes with PEG feeding while two out of three studies reported PEG feeding to be better from a nutritional perspective. *Conclusions:* Firm conclusions could not be derived on whether PEG feeding is beneficial over NG feeding in older persons with non-stroke dysphagia, as previously published literature were unclear or had a high risk of bias. A well-designed and adequately powered RCT, which includes carer strain and quality of life as outcome measures is therefore urgently needed.

**Key words:** Enteral feeding, gastrostomy, nasogastric tube, aged, non-stroke dysphagia.

## Introduction

The National Hospital Discharge Survey (NHDS) in the United States reported the prevalence of dysphagia among older individuals aged 65 years and older as 0.51% (1). However, in hospitalized elderly patients with pneumonia the prevalence of dysphagia has been reported to be as high as 55% (2), while a systematic review reported the prevalence of dysphagia after stroke as 37% to 78% (3). Although occasionally a part of the ageing process, dysphagia among older people usually results from organic diseases such as stroke, neurodegenerative diseases or malignancy. Regardless of the underlying aetiology, dysphagia is known to result in significant malnutrition, with its' recognised consequences (4). Increased morbidity, such as infections and poor recovery, compounds the problem of dysphagia in elderly patients with debilitating organic disease. Malnutrition in diseases such as stroke has additionally been shown to have a direct impact on survival (5).

As a result of the consequences of dysphagia in the elderly, enteral tube feeding has been recommended by most nutritional guidelines to prevent malnutrition (6-8). In the short-term, this is usually achieved by nasogastric (NG) tube feeding. However, if longer term enteral tube feeding is required, then feeding via a gastrostomy tube is currently recommended (7). There are several reasons for this. Firstly, long-term NG tube feeding is recognised to result in numerous complications including tube dislodgement, aspiration, nasal trauma, etc. (9). Secondly, feed interruptions from tube dislodgement can lead to inadequate nutritional intake. Thirdly, several studies have shown that feeding via a percutaneous endoscopic gastrostomy (PEG) tube is superior to NG feeding from both a nutritional and clinical perspective.

Most of the evidence for the superiority of PEG feeding has been based on randomized trials comparing PEG with NG in patients with stroke-related dysphagia. Hamidon et al. revealed that serum albumin level in PEG patients were significantly higher than patients with NG feeding after 4 weeks of intervention. The study included 23 patients recruited within seven days of their incident stroke. During the study period, no treatment failure occurred in the PEG group but 50% occurred in the NG group (10). Another study included 30 participants with a mean age of 77 years. All patients were diagnosed with a dense hemiplegia, clinical evidence of a severe stroke. The results showed a significant difference in mortality at six weeks between patients with NG and PEG with eight deaths in the NG group and two deaths in the PEG group. Moreover, patients with PEG exhibited a mean improvement in anthropometric measurements after follow up. Meanwhile, patients with NG showed a fall in anthropometric measurements (11).

The Cochrane systematic review on PEG vs. NG feeding in patients with acute stroke reported significant reductions in mortality rates and treatment failure rates in patients who received PEG feeding compared to patients who received NG

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feeding. Patients who received PEG also had a significantly better nutrition status (12).

Although the evidence for PEG feeding in stroke patients with dysphagia is clear, its' benefits in older patients with non-stroke related dysphagia are less obvious. We conducted a systematic review to examine the evidence in order to determine whether PEG feeding is superior to NG feeding in older patients with non-stroke related dysphagia.

## Methods

### *Search strategy*

Relevant peer reviewed and English Language articles were identified by searching the following databases: Ovid MEDLINE (1946 to 2013), EMBASE (up to 18 December 2013), the Cochrane Library (up to 18 December 2013), Web of Science (up to 18 December 2013) and PubMed (up to 18 December 2013). The search terms used were «percutaneous endoscopic gastrostomy», «gastrostomy», «PEG», «nasogastric», «nasogastric tube», «nasogastric feeding» and «intubation». The PubMed search for studies was performed without restrictions by using the Medical Subject Heading (MeSH) terms "Intubation, Gastrointestinal" OR "Enteral Nutrition" AND "Gastrostomy". The titles of all articles were screened and the abstracts of potentially relevant articles were read in full. In addition, the references of all selected articles were reviewed in order to identify potentially suitable articles that were indexed differently. This process was completed by two of the authors (MHJ and MPT). Full text articles were then retrieved for articles identified as potentially suitable. Data were extracted from the articles by two authors. Disagreements were resolved by discussion.

### *Study selection*

We observed the PRISMA statement for the reporting of systematic reviews and meta-analysis (13). We included all types of studies, including randomized controlled trials (RCTs) and non-RCTs comparing PEG with NG feeding for non-stroke elderly (60 years old and above) where dysphagia was diagnosed in a variety of medical conditions. In mixed samples, we included studies with participants that had a mean age of 60 years and above. All articles were required to have PEG feeding performed by any method as their intervention and NG tube feeding as their control arm. We did not include any other methods of enteral tube feeding. We also excluded articles that focussed mainly on acute, sub-acute stroke or head and neck patients. The primary outcome of interest was aspiration pneumonia and any other complication rate as defined by any event that can interrupt the nutritional status such as tube clogging, tube dislodgement and diarrhoea. Secondary outcomes were mortality rate, nutritional status as measured by proportional body weight difference, serum albumin level, haemoglobin and anthropometry measurements, such as triceps skin fold thickness and mid-arm circumference, time on enteral nutrition and quality of life.

### *Data extraction and risk of bias*

Two authors independently extracted and recorded data on study characteristics including methods, participants, interventions and outcomes (MHJ and MPT). All studies which met the selection criteria were subsequently included. The quality of the studies was assessed using the Cochrane Collaboration's tool for assessing risk of biases (14).

### *Statistical analysis*

Meta-analyses for primary and secondary outcomes were conducted using the Revman 5.2.7. For dichotomous and continuous variables, we measured risk ratio (RR) with confidence interval (CI) of 95%. Risk ratios were reported first of all for all studies, and subsequently for RCTs alone. The statistical heterogeneity between the studies was assessed by using the I2 statistics. We considered I2 values of 25%, 50% and 75% as low, moderate and high, respectively.

## Results

### *Literature search and study selection*

We identified 1568 articles through database searching. After removing duplicates, we screened the titles of 1544 articles, and excluded 413 articles at this stage. The abstracts of 1131 articles were reviewed. 1089 articles were excluded after this stage. The primary reason for exclusion was no comparison between NG and PEG feeding. Other reasons for exclusion were inclusion of only stroke or head and neck patients. We also excluded review articles. The full text articles were retrieved for 42 articles, and 15 articles were shortlisted. Many articles recruited patients with a mean of age of below 60 years. We assessed 15 potentially relevant articles including 3 articles obtained from cross-referencing. The two reviewers agreed to exclude 6 articles for the following reasons; one study involved only a survey of 4 patients and 12 carers on PEG and NG feeding (15), two studies performed gastric decompression studies (16, 17), one study included head and neck patients (18), one study investigated the oral flora in patients with PEG and NG tubes (19) and the remaining study was a retrospective non-comparative study (20). Nine studies were included in our qualitative and quantitative analyses (Figure 1). The characteristics of the included studies are reported in Table 1.

The risks of bias in the included studies are shown in Figure 2. The RCT (n=2) conducted by Yata et al. (21) did not specify their randomization method, and was therefore considered of unclear risk of bias. Park et al. (22) stated that they used computer generated number sequences and was considered at low risk of bias. The method of allocation concealment reported by Park et al. (22) was using sealed envelopes, which were therefore considered at low risk for allocation concealment bias. The study by Yata et al. (21) was considered at unclear risk of bias as inadequate information was provided for allocation concealment. The remaining studies (n=7) were non-RCTs and were considered at high risk of systematic

errors of a methodological nature. Blinding of outcomes was not possible due to the nature of the interventions for all but one of the studies. All studies were therefore judged to be of high risk of performance and detection bias, apart from Lee and Shiun (23) which was considered as at unclear risk as the authors did not specify whether the interpreters of the scans were blinded to the treatment status. Attrition bias was considered high for two studies (24, 25) due to the high dropout rates, particularly in the NG arms. Three studies (26-28) did not report mortality outcomes separately for the two arms, and were therefore considered at high risk of reporting bias. Two studies (22, 23) reported all expected outcomes which we considered at low risk of attrition and reporting bias. The other two studies (21, 29) were considered at unclear risk as the authors did not specify information on missing data. Three studies were considered at high risk of reporting bias due to high dropout rates (25) and the authors did not report mortality separately for the two arms (26, 28). All studies (22-24, 27, 29) reported relevant outcomes which we considered at low risk of bias except Yata et al. which only published an abstract. We considered the latter study at unclear risk of bias. All included studies were considered at high risk of other biases mainly due to weaknesses in their methodology. Ciocon et al. (28) included patients with oesophageal obstruction who were unable to have NG tubes, Rio et al. (29) included patients who refused gastrostomy in their NG group, Lee and Shiun (23) only included data from one week's observation, and Azzopardi and Ellul (27) compared complication rates in patients who had NG tubes before PEG insertion with complications after PEG insertion. Dwolatzky et al. (24) conducted an observational study on NG and PEG feeding and Park et al. (22) reported a 95% (19/20) dropout rate in the NG group due to the failure of treatment and death. Yata et al. (21) only published an extended abstract, and Attanasio et al. (26) and Kumagai et al. (25) did not report baseline characteristics for the two groups. Overall, the RCTs were judged to have unclear risk of selection bias, with high risk of attrition and reporting bias due to blinding difficulties. All the remaining studies were non-RCTs, and contained high risk of biases in selection, blinding, attrition and reporting.

The final selection included 2 randomised controlled trials, 4 cohort studies, 1 case control study and 2 retrospective studies. This yielded a sample of 847 subjects (PEG n=406 and NG n=441) from the nine selected studies. The mean age of study participants was 75 ± 8.1 years and the main indications for enteral tube feeding were dementia and neurological disease. The duration of follow-up in all studies ranged from 4 weeks to 6 months (21, 24-26, 28).

### *Overall analysis*

*Aspiration pneumonia*

We considered aspiration pneumonia separately in addition to overall complications as pneumonia is a commonly reported outcome. The outcome of aspiration, pneumonia or aspiration pneumonia was evaluated in five studies (394 participants). Ciocon et al. (28) used radiographic and clinical evidence of aspiration pneumonia. Dwolatzky et al. (24) and Attanasio et al. (26) reported aspiration as their outcome, no definition for aspiration was stated in their report. Kumagai et al. (25) reported aspiration pneumonia but did not state their diagnostic criteria. Azzopardi and Ellui (27) reported pneumonia episodes based on the number of documented episodes of pneumonia in patients' hospital records. The results showed pneumonia occurred in 23.08% (42 out of 182) patients in who received PEG feeding and 32.55% (69 out of 212) patients who received NG feeding. The RR using the fixed-effect model was 1.18 (P = 0.28) with a 95% CI of 0.87 to 1.60 (Mantel-Haenszels statistical method). The result is shown in Figure 3. If only randomized trials were included, aspiration pneumonia occurred in 37.29% of patients with NG feeding (22 / 59 patients) and 26.23% patients with PEG feeding (16 /61 patients). The pooled analysis revealed a RR of 1.43 (95% CI= 0.87 to 2.34) for pneumonia occurrence, indicating no significant difference in risk between PEG and NG cases (Fig 4).

**Figure 1**
Flow diagram of the selection of studies

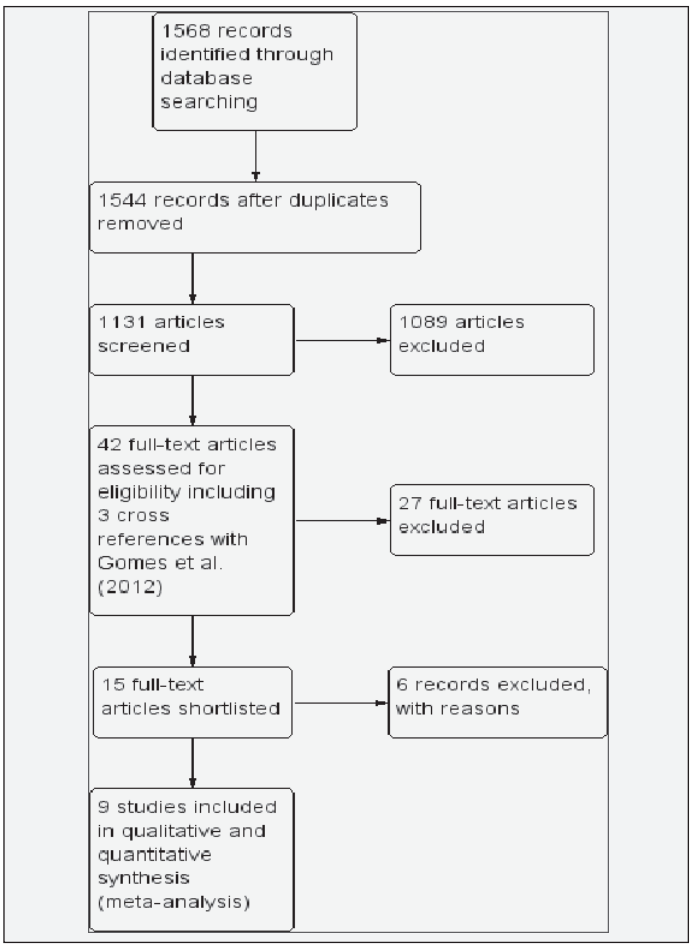


**Table 1**
Summary of studies evaluating PEG and NG feeding

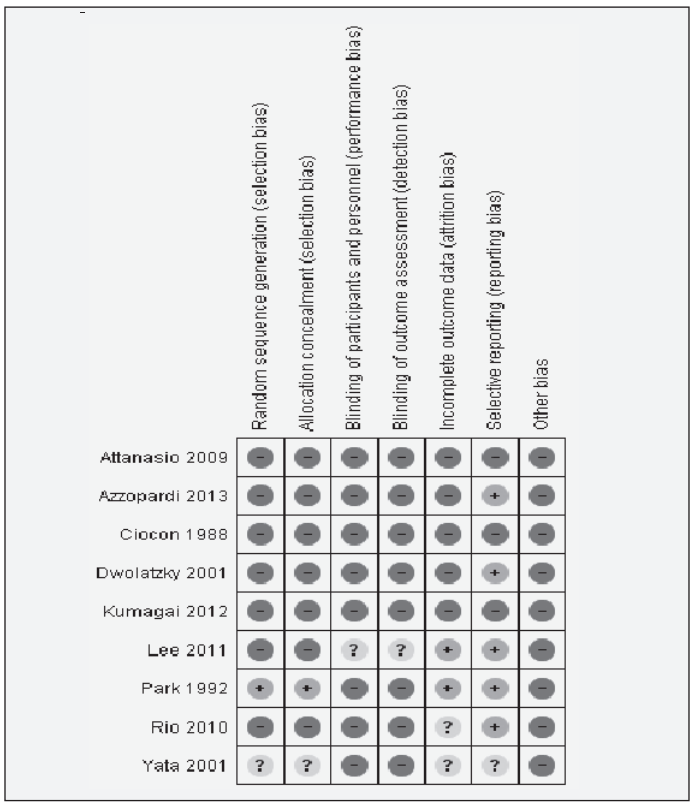
| Reference (PEG vs. NG) | Total Participants | Mean Age (Years) | Indications | Study Design | Interventions | | Duration | Outcome Measures | Group Differences |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | PEG Group | NG Group | | | |
| Ciocon et al. 1988 | 70 | 82 | Esophageal obstruction; dysphagia without obstruction; refusal to swallow | Single-centre observational study | silicone tubing (n=13), Foley's (n=3 | 12 to 18 F polyvinylchloride and silicone tubes (n=54) | 11 months (early complications <2 weeks; late complications >2 weeks) | Self-extubation<br>Aspiration Pneumonia*<br>All complications (late)<br>Mortality, Albumin, Haemoglobin & Haematocrit | 7/16 vs 36/54 (early), ns; 0/16 vs 21/54, p<0.003 (late)<br>9/16 vs 23/54, ns (early); 9/16 vs 24/54, ns (late)<br>15/16 vs 38/54 early); 14/16 vs 35/54<br>Not reported separately for PEG and NG fed patients |
| Park et al. 1992 | 40 | PEG=56; NG=65 | neurological disease | Multicentre randomised trial | 20F silicone tube Bard 20 Fr NG (n = 20) | Fine bore polyurethane (I=850 mm; diameter=1.5 mm) | PEG: 28 days; NG: mean= 5.2 | Treatment failure<br>Complications<br>Anthropometry (weight, mid-arm circumference, triceps skin fold) | 0 vs. 95%<br>15% vs. 0<br>Too many dropouts in NG group for comparisons |
| Yata et al. 2001 | 82 | PEG=75; NG=77 | Cerebrovascular disease; dementia; Parkinson's disease; others | Single-centre randomised controlled trial | Not stated* | Not stated* | Nutrition and complications =6 months;<br>Survival up to 46 months. | Nutrition 3 months-<br>Albumin (g/l), mean<br>Haemoglobin (g/dl)<br>Cholesterol (mg/dl)<br>6 months-<br>Albumin (g/l)<br>Haemoglobin (g/dl)<br>Cholesterol (mg/dl)<br>Pneumonia<br>Survival (months), mean (SD) | <br>3.6 vs 3.2, p<0.01<br>11.9 vs 11.7, ns<br>184 vs 172, ns<br><br>3.9 vs 3.1, p<0.01<br>12.4 vs 11.1, ns<br>184 vs 152, p<0.05<br>7.1(2.9), p<0.05<br>34% vs 55%, p<0.05<br>11.4(1.6) vs |
| Dwolatzky et al 2001 | 122 | PEG=85; NG=82 | Food refusal, neurogenic dysphagia | Multi-centre non-randomised clinical study | Locally accepted methods | Not stated | PEG, mean (SD)= 276.9 (184.6) days NG=102.1(127.5) days | Mortality<br>Aspiration<br>Self-extubation<br>Albumin and weight ratio at 2, 4, 12 weeks | HR(95%CI)= 0.41(0.22-0.76)<br>HR=0.48(0.26-0.89)<br>HR=0.17(0.0.5-0.58)<br>No significant difference except albumin at 4 weeks. |
| Attanasio et al. 2009 | 108 | 78 | Italian Society of parenteral and enteral nutrition guidelines (dementia, n=72) | Multi-centre observational study | 15 Fr Fresenius-Kabi AG, inserted by pull technique (n = 62). Includes 1 individual with jejunostomy | 8F, fine bore, polyurethane, radio opaque, 110 cm long (n = 45) | 12 months | Aspiration<br>Displacement<br>Tube clogging<br>Mortality | 7.9% vs. 15.5%<br>4.7% vs. 62.2%<br>7.9% vs. 11.1%<br>Not reported separately for the two groups |
| Rio et al. 2010 | 159 | 62 | Motor neuron disease | Single-centre retrospective case note review | Endoscopic or radiologically inserted gastrostomy (RIG) | Inserted in those who refused gastrostromy | Not stated, but all patients had died by end of study | Median survival (IQR), PEG vs RIG vs NG | 200(106-546) vs 216(83-383) vs 28( 14-107); gastrostomy vs NG, p=0.034 |
| Lee and Shiun 2011 | 15 | 75 | Stroke (10), dementia (2), head injury (1), Parkinsonism (1), nasopharyngeal carcinoma (1) | Inter-individual comparisons before and after PEG insertion | 24F feeding tubes with Ponsky's pull method (n = 15) | Not stated | 1 week | Gastro-esophageal reflux (GER) | 65% reduction in GER with PEG (p=0.028) |
| Kumagai et al. 2012 | 261 | 79 | Dementia | Single-centre observational study | Not stated | Not stated | 6 months for albumin and pneumonia, 27 months for mortality | Albumin (g/d1), mean (SD)<br>Aspiration Pneumonia<br>Mortality | 2.9(0.6) vs 2.9(0.5), p=0.84<br>36/96 vs 54/68<br>131/151 vs 102/106, p=0.019 |
| Azzopardi and Ellul 2013 | 97 | Not stated (only patients >65 years included) | Stroke, progressive muscle degeneration, malignancy and persistent vegetative state | Single-centre retrospective study of all patients undergoing PEG insertion | Referred for PEG after speech therapy assessment | 55 patients who had NG tube feeding before PEG | 1 year for PEG; 85.3 (range=7-348) days for NG | Pneumonia rate (ratio of days of hospitalization due to pneumonia / days on NG/PEG feed) | P<0.005 between PEG with prior, PEG without prior NG and NG feeding |

*Overall complications*

The outcome of overall complication rates including pneumonia was evaluated in three studies (146 participants). The complications included in our studies included all method-specific and common problems during the time of enteral feeding (18, 22). Ciocon et al. (28) reported evidence of agitation requiring multiple tube reinsertions and restraint of extremities and other tube-related problems. Rio et al. (29) revealed complications post procedure. The results showed 57.14% (32 out of 56 patients) in the PEG group and 53.33% (48 out of 90 patients) in the NG group had complications. The RR using the fixed-effect model was 0.80 (P = 0.07) with 95% CI 0.63 to 1.02. The results are shown in Figure 5. Ciocon et al. (28) reported a 93.75% (15/16) early complication rate in their PEG group and 70.37% (38/54) in their NG group. Park et al. (22) reported that three patients developed complications in their PEG group but none in their NG group. Rio et al. (29) reported severe pain as common complications in both groups.

**Figure 2**

Risk of bias summary: review authors' judgements about each risk of bias item for each included study




*Nutritional Status*

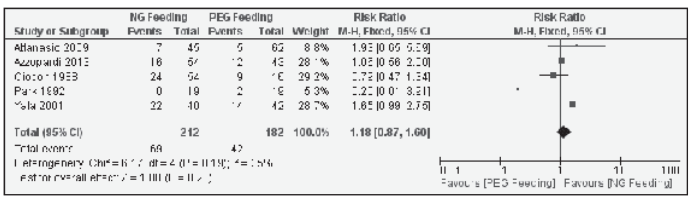
Pooled data for nutritional assessments was not possible due to the different methods of assessments reported by the studies. Five out of 10 studies assessed nutritional status after PEG or NG feeding. Ciocon et al. (28) reported laboratory measures of albumin, haematocrit and haemoglobin, but did not consider the results separately for the two groups. Park et al. (22) attempted to assess anthropometry measures, but was unable to make meaningful comparisons due to excessively high dropout rates in their NG feeding group. Yata et al. (21) reported serum albumin, haemoglobin and cholesterol levels at three and six months. Dwolatzky et al. (24) reported albumin and weight ratio at two, four and 12 weeks. Kumagai et al. (25) reported only 6-month albumin levels. Yata et al. (21) reported significant improvements in albumin levels at 3-6 months, and significant improvements in cholesterol levels at six month, but no significant changes in haemoglobin at both time points. Dwolatzky et al. (24) found significantly larger improvements in PEG fed patients compared to NG fed patients at 4 weeks, but no significant differences in albumin or weight ratio between their two groups at the other time points. Kumagai et al. (25) did not find any significant differences in albumin levels between their PEG and NG fed participants.

*Mortality*

We could not perform a meta-analysis for the outcome of mortality due to an unacceptably high heterogeneity between the studies (I2 = 79%). None of the two randomised trials reported any results on mortality. Of the seven non-randomized studies, three studies reported mortality outcomes, but four studies did not report specific mortality rates for their PEG and NG groups. Dwolatzky et al. (24) reported that PEG patients lived significantly longer than NG patients (HR = 0.41; 95% CI 0.22 to 0.76). Kumagai et al. (25) revealed that the survival rate of PEG patients was significantly higher than NG patients at 27 months, with a 87.10% (135/155) death rate for patients in the PEG group compared to 96.23% (102/106) for patients in the NG group. Rio et al. (29) stated that the 180-day mortality was 48% for their PEG group and 88% for their NG group (p = 0.001).

**Figure 3**

Forest plot of aspiration pneumonia complicating NG and PEG feeding




## Discussion

We carefully interpreted the findings of the present review as many studies were not randomised trials. We considered non-randomized studies as low quality studies. Not all randomized studies clearly reported random sequence generation and allocation concealment. As a NG tube will also be visible to both participants and assessors, it was not possible to blind the participants or assessors for clinical outcome assessments,

all studies were therefore at high risk for performance and detection bias. Many authors tried to reduce the attrition and reporting bias by presenting the flow of patients and relevant outcomes. However, all except two studies (22, 23) did not report outcomes stated within their study objectives, failed to account for missing data, experienced high dropout rates, or failed to report mortality separately for both groups. The mean of participants included in each of our studies was 106 patients. The most likely reason for the small sample sizes in most of the studies was the high cost of the procedures and enteral feeds (30). The quality of the studies from which we have based this systematic review, therefore, was overall of poor quality.

**Figure 4**
Forest plot of aspiration pneumonia complicating NG and PEG feeding in randomised trials

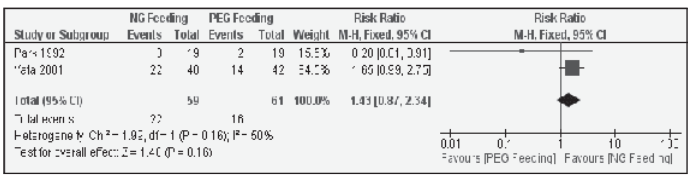
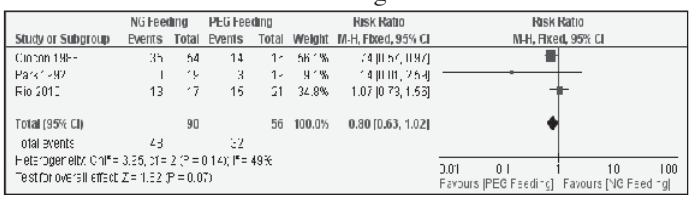



**Figure 5**
Forest plot of overall complication rates with NG and PEG feeding




Aspiration pneumonia occurs when food, saliva, liquids, vomitus or stomach contents are inhaled into the lung. The likelihood of aspiration increases when the swallow mechanism is affected from neurological conditions or structural problems affecting the oropharynx or oesophagus (31). The subsequent development of pneumonia from aspiration is also dependent on numerous factors including the cough reflex, volume of aspirate and the integrity of the immune system. Aspiration pneumonia can also occur from regurgitation. It has been postulated that regurgitation is more common in patients with NG tube feeding, as the passage of the NG tube through the cardiac sphincter of the oesophagus compromises the integrity of the sphincter (23). Our meta-analysis on aspiration or pneumonia outcomes did not show any significant difference between NG fed and PEG fed patients. It is likely that as aspiration usually results from the presence of multiple risk factors rather than a single deficit, the reduction in risk of regurgitation alone may not have an overall beneficial effect in our selected patient group of individuals with non-stroke dysphagia. In addition, two studies (32, 33) demonstrated that PEG insertion decreased oesophageal sphincter pressure in patients which could increase gastroesophageal reflux. The diagnoses of aspiration or pneumonia in our studies were not verified by post-mortem. Only Ciocon et al. (28) reported using radiological or clinical criteria for aspiration pneumonia, while the diagnostic criteria were unclear in the remaining studies.

Pooled data demonstrated that overall complication rates were similar in both types of feeding. The overall complication rate was, however, a composite measure of potential complications occurring from both types of feeding. One study reported that NG and PEG feeding had equal tube clogging problems (18, 26). Clogging of tubes can result from the administration of medications in the form of crushed tablets or capsule, instead of a liquid form (9). Although some studies (26, 28) revealed that nasogastric tube dislodgement was common, dislodgement can be prevented. Anderson et al. (34) created a nasal loop which could prevent accidental removal whilst increasing the amount of prescribed daily feeds the patients received. In addition, protective mittens have been shown to reduce the frequency of tube dislodgement (9), but they may have a negative impact on the quality of life of the patient. Attanasio et al. (26) suggested that if good nurse training and domiciliary follow-up were provided for both types of the feeding, low complication rates can be expected. This was supported by Alvarez et al. (35) which demonstrated that good quality of care determined the overall complications of the tubes.

Previous studies involving stroke patients have suggested better nutrition outcomes with PEG feeding compared to NG feeding. A randomized study (11) which compared PEG feeding and NG feeding in patients with acute stroke reported that malnourished patients were likely to develop complications and a reduced survival rate. Their study showed that PEG feeding was superior in terms of nutritional status. As mentioned earlier Hamidon et al. (10) revealed higher serum albumin levels in PEG fed acute stroke patients compared to NG fed patients after 4 weeks of intervention. Malnutrition among elderly inpatients is common, particularly those with dysphagia (36, 37). Five of the ten studies included in our systematic review reported laboratory or anthropometric measures of nutritional status, but only three of the studies reported differences between the two groups. One study reported sustained improvements in albumin levels after 6 months (21), while one study found improvements only at 4 weeks, but not 12 weeks (24). The remaining study showed no significant improvement (25). Therefore, while previous evidence favours PEG feeding in stroke patients, it remains unclear whether PEG feeding is superior to NG feeding in older patients with non-stroke dysphagia.

Pooled data to assess mortality rate was not possible due to the significant heterogeneity of our studies. Three studies which reported group-specific mortality outcomes (24, 25, 29), suggested significant mortality in their NG fed patients. Mortality among patients with dysphagia is likely to be high, as it is influenced by numerous factors including the underlying

disease process. In conditions such as motor neuron disease and dementia, which are progressive and life-limiting, dysphagia often occurs at the later phases of these conditions (38). Presence of pressure sores also influenced the mortality of the patients (39). Previous studies have also suggested that PEG feeding may be of limited benefit compared to oral feeding in patients with dementia. Murphy and Lipman (40) compared the survival of individuals with dementia who received PEG feeding with those who refused PEG insertion, and found no significant survival advantage in their PEG feeding group.

Our systematic review included mostly poor quality evidence comparing PEG feeding with NG feeding, and only two of the nine studies included were RCTs. It is therefore difficult to draw firm conclusions in favour of PEG feeding or NG feeding in patients with non-stroke dysphagia. A well-designed and adequately powered RCT is therefore much needed. However, robust RCTs in this group of patients will be highly challenging, as these patients are often physically quite frail and highly susceptible to physical insults, which will significantly affect the attrition rate of such a study. Other challenges have been highlighted in our results and discussion sections, and these include the impossibility of blinding and the difficulty in ensuring equal follow-up duration between groups. Our findings, however, suggest that there are no differences in aspiration or pneumonia outcomes as well as overall complication outcomes between PEG fed and NG fed patients. However, based on reported mortality, more studies favour PEG feeding for mortality outcomes. The meaningfulness of added survival for this group of patients may also be questionable, and few studies have addressed carer burden and quality of life. The choice for PEG feeding or NG feeding may ultimately be better dictated by local expertise, patient related factors, patient preference, as well as cost-effectiveness and future studies into these factors are urgently required.

## Conclusion

Our search of existing databases found only two small RCTs and seven non-randomized studies directly comparing PEG feeding with NG feeding among older patients with non-stroke dysphagia. Pooled data on aspiration pneumonia and overall complication rate suggested no significant difference in these outcomes between the two methods of enteral feeding. A meta-analysis was not possible for mortality outcomes, but three studies reporting mortality or survival suggested improved mortality outcomes with PEG feeding. The quality of the studies included in our systematic review, however, precludes any firm conclusions on whether PEG feeding or NG feeding is preferable in patients with non-stroke dysphagia. In addition, survival outcomes may be of limited value, and future studies should also address factors such as cost-effectiveness, quality of life and patient autonomy.

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*Conflict of interest:* The authors declare that they have no conflicts of interest.

*Ethical standards:* This study was conducted using standardised and accepted methods for systematic reviews and meta-analyses.

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