



Effectiveness of Texture Modified Diets on Dysphagia in Older adults: A Systematic Review

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ABSTRACT

Dysphagia is common among older people and is associated with an increased risk of aspiration pneumonia, dehydration, and malnutrition. Treatment options are limited, and the use of texture-modified diets is a widespread clinical practice in geriatric care. This systematic review aimed at evaluating the evidence available using keyword searches by using recognized electronic databases from 2011 to 2021. Studies were evaluated for their acceptability, then reviewed with data extracted, and grouped by types of outcome measures. A total of 136 publications were identified, and only 10 studies met the inclusion criteria. There were no publications examining the effectiveness of texture-modified diets for older adults (≥ 60 years) exclusively with dysphagia. However, many studies which had included subjects with dysphagia and texture-modified diets in managing aspiration and providing nutrition and hydration in settings like residential aged-care facilities and hospitals were reviewed in this paper. This review identified the gaps in the area and showed the strong grounds for the need of clinical trials to guide the best practices.

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INTRODUCTION

The percentage of the older adult population is growing fast, and this expands the average life span of people. However, many older adults suffer degenerative diseases and nutrition problems that eventually lead to negative health consequences. Data pertaining to world population aging suggests that by the year 2050 one fifth of the population of the developed world will be over the age of sixty years and for the first time in history there will be more older adults than young (World population Ageing, 2001). Dysphagia is classified into three main categories: oral, esophageal, and pharyngeal (Thiyagalingam *et al.*, 2021). Swallowing disorders can impair the entering of bolus, liquid, or saliva to the larynx. Dysphagia is caused by a neurological or anatomical disorder that interferes with sufficient fluid and food intake (Copeman & Hyland, 2014). Dysphagia affects the safety and effectiveness of an individual's swallowing function. Safety during swallowing typically refers to the degree of risk of aspiration or entry of food and liquids into the airways below the true vocal cords. Efficacy refers to each patient's efficiency and speed during swallowing food and liquids. Over the past decade, there has been a rising awareness that dysphagia should be recognized as a geriatric syndrome (Payne & Morley, 2017) because, it has a considerable impact on the efficiency and safety of swallowing function in older adults (Baijens, 2016).

Early recognition and proper management of dysphagia are important steps in geriatric care. Symptoms associated with dysphagia in older adults are often overlooked by the patients themselves. Various countries all over the world have documented guidelines for formulating diets for patients with dysphagia. However, neither of these guidelines are based on systematic reviews to summarize all the information related to the effect of dysphagia on nutritional status and the prevention of aspiration in older adults. Therefore, this systematic review

aims to summarize the evidence from the literature about the effectiveness of texture-modified diets for older adults (≥ 60 years) suffering from dysphagia with specific relevance to the maintenance of nutrition and hydration status and for the prevention of aspiration.

MATERIALS & METHODS

The PICO (populations, interventions, comparators, outcomes) method was used as the approach to identify studies that met inclusion and exclusion criteria (National Collaborating Centre for Methods and Tools, 2014). The population of interest was older adults (≥ 60 years) with the diagnosis of swallowing disorders, especially dysphagia. Interventions included only clinical-based therapies using texture modified diets (TMD). The studies examined showed the effect of TMD on at least one clinically relevant outcome.

Search strategy

The electronic bibliographic databases used for data extraction were PubMed / Medline, Elsevier, Google Scholar, ResearchGate, Hindawi, Sage pub, ScienceDirect, and SpringerLink. Searches were limited to articles published from 2011 to 2021. All titles and abstracts of each of the searches were reviewed and then the relevant articles were obtained for review. The search terms used were "Dysphagia in older adults", "Swallowing difficulty", "Aspiration", "Oral health", "Thickened diets", "Texture modified diet" or "TMD". These expressions were used separately or in different combinations. The keywords were intended to capture terms and concepts known to be used in the dysphagia in older adults, their nutrition, and texture-modified food.

Inclusion and exclusion criteria

Inclusion and exclusion criteria are depicted in Figure 1. Studies that were not published in the English language, studies that did not carry full text, studies without clinical

studies and studies done with the participation of adults below sixty years, and studies with duplicates were excluded. Before removing duplicates, the initial search results showed 136 articles. Removal of duplicates resulted in 106 articles. In addition to that, unpublished literature, editorials, review articles, conference proceedings, letters to the editor, case studies, and commentaries were also excluded. Any article that appeared to focus solely on participants who were suffering from swallowing problems for which specific reasons had been identified and not due to age were also excluded. Studies focusing on dysphagia in children were also excluded. All the studies having a clinical trial with the participation of older adults over sixty years (60 - 100 years) suffering from dysphagia secondary to non-progressive neurological conditions were included.

Data extraction

The PRISMA checklist was used for data extraction which included participants sample size, interventions, outcomes, and study design as shown in Table 2. Data of all relevant studies were extracted in a spreadsheet using EXCEL version 2019 software (Microsoft Corporation) by one reviewer. Another reviewer abstracted detail regarding the study design, sample size, interventions, outcomes, duration of treatment and follow-up, settings, and results. The abstracted data was checked for accuracy. Out of 10 studies, there were five randomized control studies and five non-randomized control trials. The risks of selection, performance, attribution, detection, and outcome reporting bias were summarized as overall risk of bias as low, some concerns, or high risk of bias.

Quality assessments

The evaluation for risk of bias was performed (Figure 2 and 3) according to the guidelines suggested by the version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2), the recommended tool to

assess the risk of bias in randomized trials (Sterne et al, 2019). The ROBINS-I tool was used to assess risk of bias in the results of non-randomized studies (Sterne et al, 2016). Specifically, each study was reviewed to determine whether there was a potential bias in terms of classification of interventions, participant selection, missing data, and reporting of results.

RESULTS

Study selection

The electronic search identified 136 records potentially eligible for inclusion. Following the manual screening of titles, abstracts, full-texts, clinical studies, English language papers and studies on older people above 60 years, 10 publications were eligible for inclusion. All the publications included were based on the older adult population over 60 years and suffering from dysphagia. Both male and female participants were studied in all the included researches.

Criteria used in the search

The questions addressed in the full-text review are listed in Table 1 and led to a final subset of ten articles selected for qualitative synthesis. The questions were addressed when including a particular study into the systematic review. This step was carried out to make sure the validity of the study when selecting exclusively the relevant articles.

Stimulus characteristics

The various food and liquid stimuli used in the studies selected for the qualitative synthesis are summarized in Table 1. Out of the 10 studies selected for systematic review, 5 studies reported comparative data for swallowing of different textured diets including thin liquid (water like liquids) and extremely thick liquids (pureed, spoon thick or mushy diets).

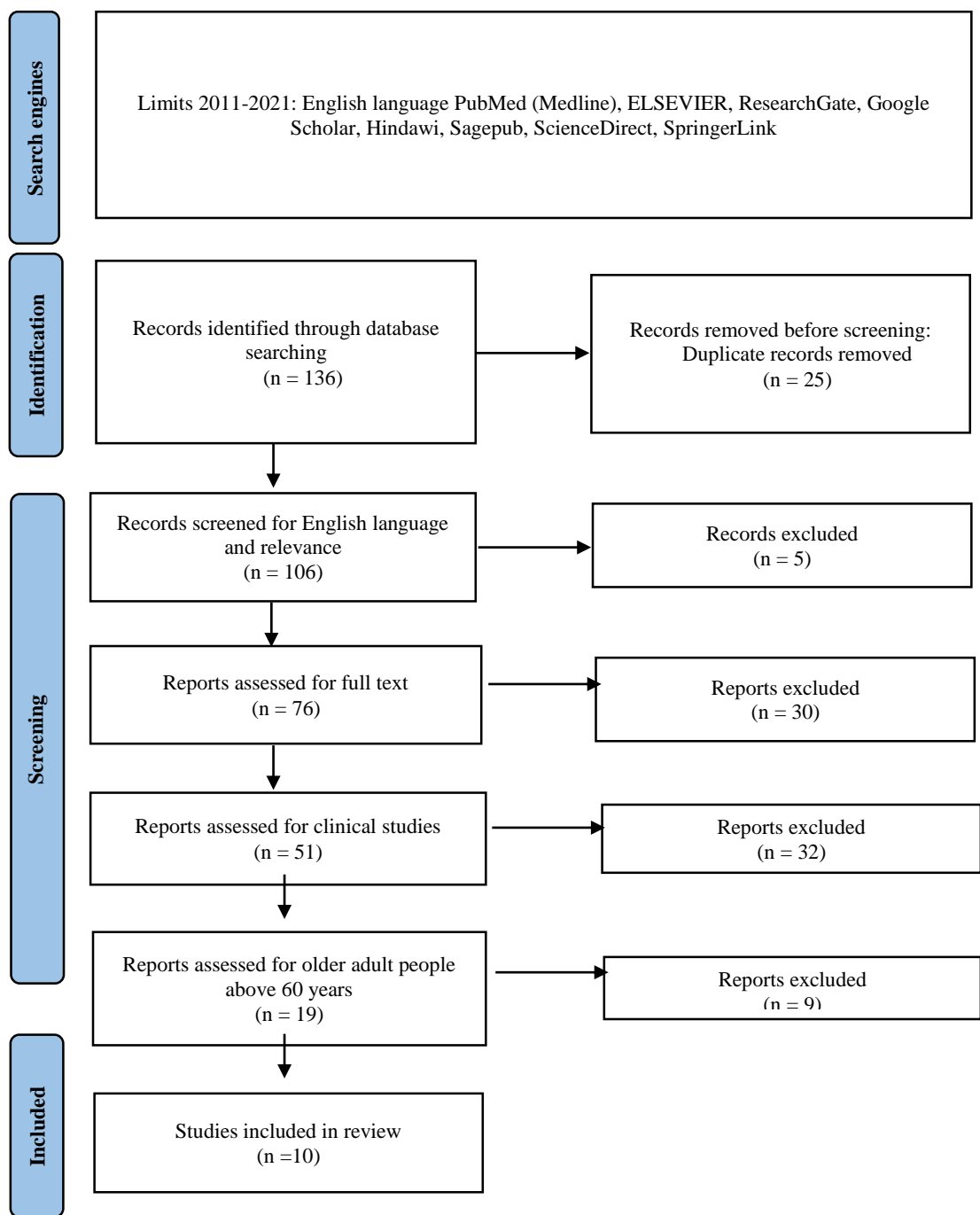


Figure 1. Illustration of experimental design

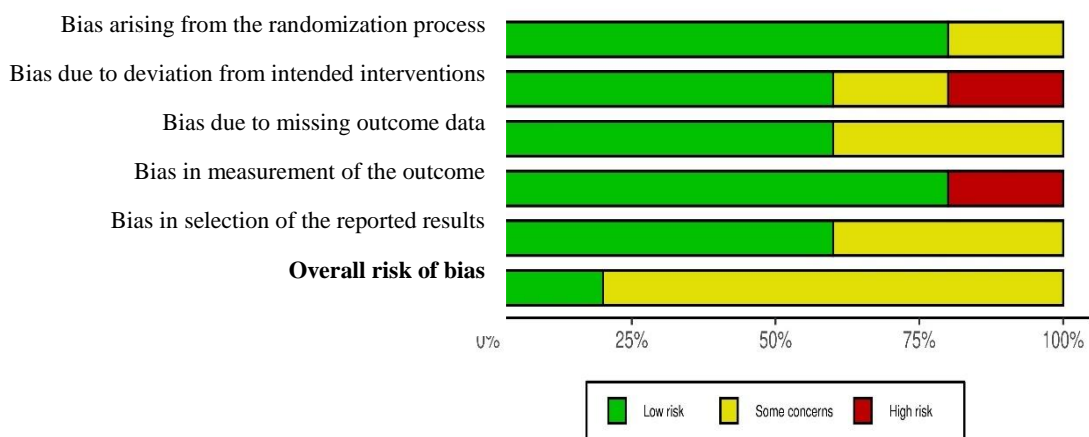


Figure 2. Summary plot on risk of bias assessment in randomized trials

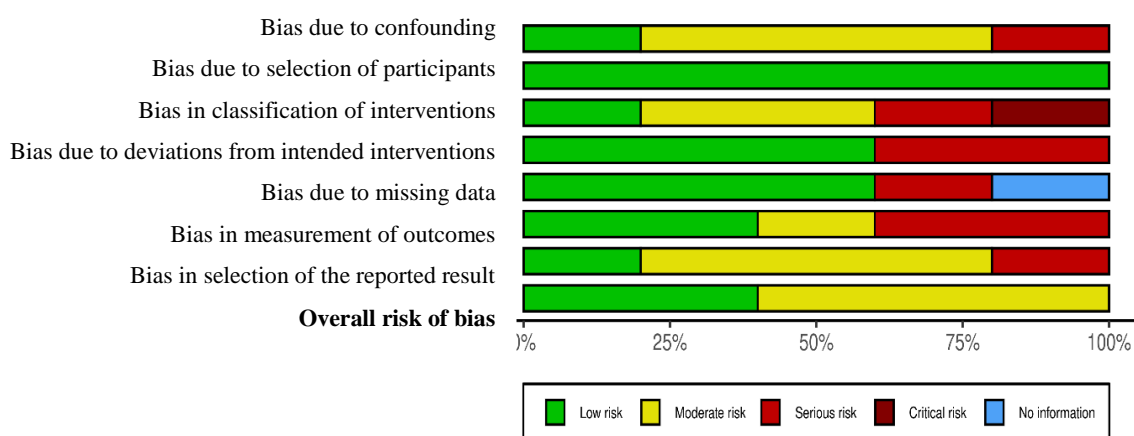


Figure 3. Summary plot on risk of bias assessment in non-randomized trials

Table 1. Questions addressed during the review of relevancy and quality in full-text

Number	Question	Clarifying instructions
1	Is the article is a peer-reviewed manuscript in a journal?	Conference abstracts should be excluded
2	Does the article report swallowing behavior in humans for at least one textures or consistencies?	Articles without original data must be excluded
3	What were the different stimuli tested?	
4	What was the research question?	Please state that clear as possible
5	Is the article published in English language?	
6	Are the participant groups clearly described as above 60 years?	
7	What is the overall conclusion or main finding of this study related to swallowing or oral processing and food/fluid texture?	

Table 2. Characteristics of the studies

Source	Method	Sample size	Patient characteristics & study location	Interventions	Outcome
Oh <i>et al</i> ,2020	Video fluoroscopic study + Clinical study	30	≥65 yrs. (Korea)	5 bolus types were required to be swallowed by each participant and two skilled physiatrists analyzed the video files. Swallowing supplement development with similar texture and smell as commercialized plain yogurt (spoon thick)	Several patients with Parkinson's disease presented "symptomless dysphagia" upon VFSS evaluation. Swallowing supplement was easier to swallow than a general diet and tolerable to patients with Parkinson's disease.
Li, 2015	A retrospective study	40 (20 from control group)	≥80yrs (China)	Mushy diet for the intervention group and semi-solid food, thick liquid for control group.	Control group, seven patients had aspiration pneumonia. Four patients had aspiration pneumonia in the intervention group.
Torres <i>et al</i> , 2019	A randomized control trial	20 (20 controls)	≥65yrs (USA)	Texture modified foods and thickened drinks diet, with nectar or pudding viscosity and controlled bolus volume	The modified consistency and volume diet improved the total energy and protein intake in the intervention group after 12 weeks.
Kyodo <i>et al</i> , 2020	randomized cross-over trial	62	≥65yrs (Japan)	Pureed rice with or without a gelling agent	Pureed diets containing a gelling agent may reduce the risk of aspiration pneumonia possibly by decreasing pharyngeal residues in elderly patients with moderate to severe dysphagia.
Taniguchi <i>et al</i> , 2014	Multicenter non-blinded prospective cohort study with 1-year follow-up	9528	Residential care patients, >65 years (Japan)	Normal vs minced vs pureed vs parenteral diet	Elderly people who serve pureed diets need to eat more food to meet their nutritional needs than elderly people who provide regular diets. Eating large amounts of food can put a significant physiological burden on them.

Table 2. Cont.

Source	Method	Sample size	Patient characteristics & study location	Interventions	Outcome
Bannerman and McDermott, 2011	Cross-sectional observational study using standard cup weights	30 (15 control)	Residential care (UK)	Normal diet vs TMD	Patient on TMD had lower total daily fluid intake than patients on a normal diet. Only 6.7% of patients on a modified diet met their daily fluid requirements compared to 33.3% of patients on a normal diet.
Rosler <i>et al</i> , 2015	Non-blinded single-subject non-randomized controlled trial	161 +30 controls	Hospital acute geriatric inpatients (Germany)	Water vs sliced apple vs pureed apple	Signs of water aspiration are more common than signs of aspiration when eating a slice of an apple. Signs of aspiration when eating apple puree are rarely seen.
Massoulard <i>et al</i> , 2011	Cross-sectional observational study	87	Residential care (France)	Normal diet vs minced diet vs mixed diet	Patients on TMD tended to have lower energy intake and protein intake compared to normal diet.
Leder <i>et al</i> , 2013	Non-blinded single-subject randomized trial	84	Hospital in patients who aspirate on thin but not thickened fluids (USA)	Moderately thick vs extremely thick fluids	Individuals who swallowed puree consistency without aspiration but exhibited aspiration with thin liquid ingested both nectar-like and honey-like thickened liquids with 100 % success at the time of testing as well as 24 hours after testing.
Keller <i>et al</i> , 2012	single-blinded single-subject randomized controlled trial with 9-month follow-up	42	Continuing care facility and residential care (Canada)	Usual commercial bulk TMD vs mixed commercial bulk vs mixed commercial bulk	Achievement of initially prescribed weight goal of gaining weight, maintaining weight, and losing weight.

PTMD = Texture modified diets, UK = United Kingdom, USA = United States of America, VFSS = Video fluoroscopic swallowing studies

Prevalence of texture modified food

There were studies of which the main objective was to find the prevalence of using TMD among older adults as in studies by Torres *et al.* (2019), Taniguchi *et al.* (2014) and Massoulard *et al.* (2011) (Table 2). The use of TMD more likely to have less detrimental effects including choking, feeding dependency, esophageal disease, poor dentition, refusal to eat, and cognitive deficits.

Aspiration and related pneumonia

There were five studies that included subjects with geriatric dysphagia. They have examined primary outcomes relating to aspiration in TMD (Table 2). Subjects had been recruited primarily from hospitalized patients care and residential care settings. One study (Li, 2015) investigated the relationship between aspiration related pneumonia in hospitalized older adults. Rosler *et al.* (2015) has investigated the frequency of aspiration with regard to the water, apple slices and pureed apples.

Nutrition and hydration

There were 3 studies out of 10 reported nutritional outcomes associated with TMD (Table 2). All of them were performed in residential care settings with an unspecified proportion of older adults suffering from swallowing problems. The studies including Massoulard *et al.* (2011), Bannerman & McDermott. (2012) compared daily energy and protein intake on normal diet versus TMD. Bannerman & McDermott. (2012) showed patients on TMD tended to have lower energy intake and protein intake compared to normal diet. Further, Bannerman & McDermott. (2021) illustrated that patient on TMD had lower total daily fluid intake than patients on a normal diet. Only 6.7% of patients on a modified diet met their daily fluid requirements compared to 33.3% of patients on a normal diet.

Most of the studies included in the review were on patients with signs of dysphagia. Seven articles out of 10 demonstrated the early signs of dysphagia in their studies. It was not possible to undertake a quantitative analysis of related results across studies due to the wide variation of instrumental methods used to measure swallowing behaviors, foods and liquids used in the selected studies.

DISCUSSION

In this systematic review, 136 journal articles were screened and selected 10 articles which contained original information related to the effectiveness of TMD for dysphagia among older adults. Very few of the articles explicitly explored effectiveness of texture modified diets. In assessing effectiveness of TMD for older adults with dysphagia, the studies identified are primarily in residential aged care facilities and in hospitals.

Studies that have shown the prevalence of TMD usage in older adults suffering from dysphagia described both the positive and negative impacts of TMD use. Torres *et al.* (2019), Oh *et al.* (2020), Bannerman & McDermott. (2011), and Li *et al.* (2015) discussed the effectiveness of various types of TMD for the older adults. Adherence to TMD varies depending on the environment, but there is no clear correlation with the type of food or fluid modification, age and severity of dysphagia. One study revealed that staff education and TMD availability improve the adherence to TMD in hospitalized patients (Bannerman & McDermott, 2011) and another study suggested that improved appearance of the TMD increases the adherence (Torres *et al.*, 2019). In several cases, the authors used synonyms to describe the viscosities of the stimuli, such as "with a viscosity similar to water", but failed to provide adequate evidence to support these descriptions. There were 4 studies: Oh *et al.* (2020), Li. (2015), Kyodo *et al.* (2020), and

Massoulard *et al.* (2011) which are concerned on an unparalleled stimulus. A total of nine items included a wide range of texture-modified foods, including spoon-thickened liquids, nectar-like liquids, honey-like liquids, pureed diets, water-like liquids, and regular normal diets. As solid food Rosler *et al.* (2015) used apple slices. In some investigations thin liquid compared to a slightly thick liquid also known as thicken with nectar and moderately thick liquid known as thick honey.

There were few studies coupled with nutrition and hydration in relation to TMD. Rosler *et al.* (2015) wanted to determine the amount of energy and protein consumed by patients with oropharyngeal dysphagia with the use of TMD. Diets thickened with nectar and pudding consistency were used. Total energy intake improved by 31% in the intervention group and also protein intake by 29% after 12 weeks of TMD consumption. Furthermore, according to them after taking TMD, body weight and BMI in the intervention group increased considerably (Massoulard *et al.*, 2011). Despite pureed diets Taniguchi *et al.* (2014) pointed out that the minced diet is rich in protein and energy intake. Leder *et al.* (2013) showed the use of thickened fluids to maintain adequate hydration in older adults with dysphagia.

Contrary to the positive effects of TMD for older people, Taniguchi *et al.* (2014) and Massoulard *et al.* (2011) discussed the negative aspects of consistency-modified diets with regards to dysphagia in older adults. A number of studies have reported that people in residential care are unlikely to meet their recommended daily energy needs, and those with TMD have a lower daily energy intake than patients on a normal diet. Taniguchi *et al.* (2014) together with Keller *et al.* (2012) demonstrated that pureed diets are more like a baby food and are not attractive to the older adults and this leads to the loss of appetite. On the other hand, blended

diets need to be consumed in large quantities to fulfill portion size and this results in a physiological burden for them (Taniguchi *et al.*, 2014). It was also identified that patients in hospital and residential care with TMD do not maintain their daily fluid requirements. Furthermore, the studies suggests that the type of texture modification should be chosen based on the chewing ability and digestive disorders of the particular patient. Otherwise, using TMD without considering the exact requirement could result in negative health outcomes with a potential of worsening the quality of life of patient. Since TMD contains less water, it causes constipation in the older adults (Bannerman and McDermott, 2011).

The second key finding emphasized in this systematic review is the reduction of aspiration and aspiration related pneumonia in older adults due to TMD. One study (Oh *et al.*, 2020) demonstrated the relationship between the swallowing analysis and aspiration prevention using texture modified food. They have used a video fluoroscopic swallowing studies (VFSS) in order to measure the swallowing physiology of geriatrics suffering from dysphagia. They suggest that in people with dysphagia, TMD reduces the risk of aspiration as seen on VFSS. Another study has used fiberoptic endoscopic evaluation of swallowing (FEES) to investigate the aspiration with regard to the puree consistency and thin liquids. It was noted that extremely thick fluids had significantly reduced risk of aspiration as modified fluid is thicker. Leder *et al.* (2013) emphasized that moderately and extremely thick fluids were equally effective for reducing aspiration. Rosler *et al.* (2015) showed that aspiration of water occurred more frequently than the apple slices and puree in patient with dementia and dysphagia.

One of the main reasons for aspiration and associated pneumonia is the accumulation of food debris in the pharyngeal area. The use of pureed diets is associated with the

reduction of those pharyngeal residues and consequently reduces the risk of aspiration pneumonia in older adults with moderate to severe dysphagia (Kyodo *et al.*, 2020). A study using four types of liquid stimuli showed that the pureed diet is effective rather than liquids similar to nectar and honey in preventing aspiration in older adults. The key finding of the study is that participants who swallowed the puree without aspiration, aspirated thin liquids (Leder *et al.*, (2013). Furthermore, Leder *et al.* (2013) concluded that the use of thickened fluids improves the safety and efficacy of the patient's swallowing.

Another study conducted in China with the participation of older adults in a hospital specifically stated that eating posture plays an important role in the prevention of aspiration in patients with dysphagia. Changing the head or body posture helps relieving symptoms associated with aspiration when eating. This study emphasized that sitting posture is the best and sitting straight and slightly forward with the body and bending the neck forward allows food to easily enter the esophagus without entering the airways (Li, 2015). However, the position must be maintained and adapted according to the physical abilities of the individuals.

This systematic review has several limitations. The risk of bias was assessed according to the guidelines suggested by the Cochrane Bias Methods Group for randomized and non-randomized studies (Sterne *et al.*, 2019). The RoB 2 tool was used to assess the risk of bias in the randomized trials and the ROBINS-I was used to assess the risk of bias in the non-randomized trials. In particular, the methods of each study were reviewed to see the presence of potential bias in terms of classification of interventions, selection of participants, missing data and reporting of results. Risks of bias were identified for most studies among the 10. Most of the studies had very small sample sizes and relatively short follow-up periods, resulting in bias in the selection of

participants and measurement of reported results. The study participants were heterogeneous, with no studies consisting exclusively of subjects with geriatric dysphagia who were given thickened diets. Although five randomized control trials were included, some of these were undermined by the lack of an adequate control group which is explained by the authors based on ethical grounds. The sample consisted of patients who aspirated or did not get aspirated regardless of the intervention used.

The systematic summary of the literature has brought to light several important insights and allowed for a number of recommendations for further research. The current evidence is not strong enough to preclude TMD and liquids as a control group for ethical reasons in future randomized clinical trials. The relationship between TMD in older adults with dysphagia and clinically relevant outcomes in nutrition, hydration, aspiration and aspiration pneumonia needs to be further explored. Other important research goals are improving TMD as a nutritional alternative to the normal diet by enriching and examining alternative strategies for managing aspiration risk in older adults with dysphagia such as comfortable eating with better oral hygiene or use of free water protocols. More research is needed to guide clinical practice on aspiration management and the use of TMD in the older adults with aspiration and dysphagia.

In order to make comparisons and take firm decisions, more literature is necessary. The impact of TMD on the older adults (≥ 60 years) with regards to nutrition, hydration and aspiration is an area that would benefit from more in-depth research and could vary significantly between countries and in health care systems. Therefore detailed exploration on the relationship between TMD in older adults with dysphagia and the clinically relevant outcomes of nutrition, hydration, aspiration and

aspiration pneumonia is needed. It can be aimed at finding contributing factors for dysphagia and reducing the incidence and severity of complications of dysphagia which lower the quality of life. Based on further studies, it is necessary to develop guidelines to manage the dysphagia among older adults.

CONCLUSIONS

Dysphagia disturbs the very foundation skills of eating and drinking of older adults. Texture modified diets are used in the management of dysphagia. This systematic review identified a number of key themes in relation to the dysphagia in older adults and a number of important gaps in literature.

Some major gaps include the understanding of the impact of liquid consistency and food texture on swallowing physiology, both in healthy and disordered older adults. The use of texture-modified foods and thickened liquids in the treatment of dysphagia in older adults is an area which need more research and provide strong grounds for clinical practice.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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