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Dysphagia

Review

The Impact of Aging on Eating, Drinking, and Swallowing Function in People with Down's Syndrome

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Abstract. Many people with Down's syndrome (DS) experience eating, drinking, and swallowing (EDS) difficulties, which can potentially lead to life-threatening conditions such as malnutrition, dehydration, and aspiration pneumonia. As the life expectancy of people with DS continues to improve, there is an increasing need to examine how the aging process may further affect these conditions. Published research studies have yet to address this issue; therefore, this article draws on the literature in three associated areas in order to consider the dysphagic problems that might develop in aging people with DS. The areas examined are EDS development in children and adolescents with DS, EDS changes associated with aging, and EDS changes associated with dementia of the Alzheimer's type (DAT) because this condition is prevalent in older adults with DS. This article concludes that unlike in the general population, the aging process is likely to cause dysphagic difficulties in people with DS as they get older. Therefore, it is suggested that longitudinal studies are needed to examine the specific aspects of EDS function that may be affected by aging and concomitant conditions in DS.

Key words: Down's syndrome — Dementia — Dysphagia — Swallowing — Deglutition — Deglutition disorders.

Disorders of eating, drinking, and swallowing (EDS), known collectively as dysphagia, are a potentially serious cause of conditions such as asphyxiation and aspiration that can lead to malnutrition, dehydration, respiratory infection, and death [1]. Dysphagia can affect many people with Down's syndrome (DS) because of a combination of anatomical, structural, and medical complications [2]. It is also known that the aging process brings about several changes in the structure and function of the EDS mechanism, which may increase the risk for dysphagia, particularly in the elderly population [3]. There exist very few studies that examine the aging process in people with DS, principally because they rarely survive to reach old age. However, life expectancy of people with DS has substantially increased over the past several decades from under 10 years in the 1920s to beyond 50 years at present [4, 5].

Although an increasing number of more recent studies look at the effects of aging on cognitive function in DS [6], there have been no published studies to date that examine how the aging process might affect specifically EDS function in DS individuals. As a consequence, early-stage dysphagia may go undiagnosed.

This literature review explores three issues relating to DS and dysphagia. Initially, studies of EDS development in the pediatric population with DS are examined for useful information about EDS problems that are likely to persist as the child ages and that may influence EDS function in adulthood. Secondly, research into the effects of aging on EDS function in the general elderly population without DS is examined given that the elderly DS adult might also experience many of the same age-related changes. Finally this article considers the conditions that have

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a higher risk of affecting EDS in the older population with DS, particularly dementia of the Alzheimer's type (DAT). This review aims to draw together information from these three areas to envisage some of the dysphagic difficulties the aging adult with DS might experience, discuss the possible implications for the management of dysphagia in this population, and propose areas for future research. A general review of the literature was performed, with key studies of interest appraised in closer detail.

Eating, Drinking, and Swallowing in Down's Syndrome

There is a paucity of large-scale studies confirming the prevalence of dysphagia in adults with DS, and many studies that compare people with and without DS consist of small groups of subjects. The majority of studies examining EDS difficulties in people with DS focus on the pediatric population [7–10]. These illustrate the range of EDS problems people with DS may experience from birth and may continue to experience throughout childhood and into adulthood. Field et al. [10] examined the patient notes of 349 children with and without intellectual disability, all of whom had at least one of the following feeding problems: delayed oral-motor skills, food refusal, narrow food preferences, texture selectivity, and swallowing difficulties. The authors discovered a significantly higher prevalence of oral-motor problems, swallowing difficulties, and texture selectivity in the 26 children with DS than in the other children without DS. Overall, these particular problems were more prevalent in those children with anatomical anomalies, cardiac or pulmonary conditions, and gastroesophageal reflux, which are commonly known conditions in children with DS [8].

The authors suggest that children with DS have the ability to chew but refuse to do so as a result of learned aversions to specific textures that prompt unpleasant experiences such as gagging and vomiting; however, most papers support an anatomical rather than behavioral origin. In their review of the literature, Hennequin et al. [2] note that the underlying facial dysmorphology in children and young adults with DS can significantly impede the chewing process. The positioning of the characteristic hypoplastic maxilla and protruding mandible can effectively lock the jaw in place and prevent lateral movements for chewing.

Spender et al. [9] also report feeding problems in young DS children who exhibited differences in oral-motor function from typically developing children. The authors used an objective oral-motor assessment to examine oral-motor function and feeding behaviors in 14 DS children ranging in age from 11 months to 3 years. Performance was compared to 58 children matched according to mental age. Oral-motor problems in the DS subjects included delayed initiation and poor coordination and sequencing of oral-motor movements, difficulty grading jaw movements for chewing, weak lip closure, and weak and reduced tongue movements. Other studies also found that DS children have primitive suck patterns, poor coordination of the suck/swallow/breathe pattern, and persistent tongue protrusion [7, 8].

Frazier et al. [8] report similar findings in their videofluoroscopic study of oral-motor skills and swallowing function in 19 young children with DS ranging in age from 3 months to 4 years. The authors also identified several cases of delayed initiation of the pharyngeal swallow reflex and subsequent aspiration of liquids, which increased the risk of respiratory infection.

Hennequin et al. [2] document several anatomical and systemic factors affecting oral and pharyngeal function and thus causing EDS problems in the child with DS. These include dental disease, occlusal disturbance, and apparent macroglossia relative to the smallness of the oral cavity. Additional relevant features include slow development of motor skills, upper airway obstruction, and hypotonia of the pharyngeal muscles and also of the tongue and the lips. All of these features are characteristic of DS and can continue to contribute to EDS difficulties into adulthood.

In addition, problems such as orofacial dyskinesias (abnormal and involuntary movements of the jaw and face), bruxism (persistent tooth grinding), and tongue protrusion are common in the DS population and are viewed as attempts to compensate for craniofacial abnormalities in order to effectuate as efficient eating, drinking and swallowing as possible [11]. These problems can become even more apparent and exaggerated when the person with DS reaches early adulthood [12].

An extensive search of the literature yielded only one study that addresses orofacial problems and EDS difficulties in adults with DS. Faulks et al. [12] performed a before-and-after observational study of 7 adults with DS ranging in age from 17 to 46 years to determine whether orofacial dyskinesia is caused in part by the abnormal orofacial structure in people with DS. The authors investigated this by attempting to correct the facial dysmorphology and stabilize occlusion via a bite-raising appliance or denture and then by examining whether this would reduce the orofacial dyskinesia and associated EDS problems. Each patient had been referred to the same specialist

dental clinic for problems with chronic mouth breathing, orofacial dyskinesia, tongue protrusion, and/or severe bruxism. Caregivers reported that these problems had become more severe in late adolescence/early adulthood. Multiple EDS problems were observed in each patient. These included difficulties establishing an anterior seal for the swallow, swallowing food without chewing, the tongue pushing food out of the mouth, dyskinetic tongue movements that interfered with oral-motor control, an anterior gag reflex, coughing, and in one case choking. After eight weeks of adaptation to the appliance or denture, each patient's caregiver was interviewed. All reported reduced tongue protrusion, decreased or ceased dyskinetic movements, decreased or ceased bruxism, ceased coughing, and more thorough chewing of food. For the case in which choking was an additional problem, choking episodes were reported to have ceased following treatment.

Whilst the Faulks et al. study has some strengths, e.g. patients attending the same specialist clinic, and set inclusion/exclusion criteria, there are several significant limitations. The sample size of seven was very small and therefore it is difficult to suggest that results may be representative of the general population of adults with DS. It could also be argued that the clients were selected based on the level of motivation of the parent/carer and, given the invasiveness of the treatment, compliance of the client. No formal assessment was used in the diagnosis of oral dyskinesia. The use of an objective oral-motor assessment would have increased internal validity of the baseline and treatment results. The interviews with caregivers were unstructured and the authors did not describe the nature of their questioning. The wording of interview questions may have influenced the carers' answers and their willingness to respond. It was also not specified whether the interviewer was blinded to the purposes of the study. Both carer and interviewer may have been motivated to seek positive changes in the clients, leaving room for bias. The treatment results themselves were not measured and were based purely on the subjective opinions of the carers. The carers had to rely on what they remembered of the client's problems before treatment, which would have affected the accuracy of their responses. This could be improved through a structured and standardized questionnaire administered to carers both before and after treatment.

With no separate control or comparison group in this study, it is difficult to evaluate effectiveness of the treatment. A clinical trial with a much larger and random sample of adults with DS to improve generalization of the findings and with a structured protocol allowing for testing against a control group would have been a more valid method of determining effectiveness of this new treatment.

The key strength of the Faulks et al. study is that it shows that the characteristic orofacial structure in people with DS can have a profound effect on their EDS function and that it can change or even worsen when the adolescent stops growing and approaches adulthood. However, the poor choice of study design and lack of adequate outcome measures makes it difficult to determine validity of the authors' conclusion that stabilizing occlusion improved aspects of EDS function.

In addition to oropharyngeal problems, a higher prevalence of esophageal motor disorders, particularly abnormalities in esophageal peristalsis and lower esophageal sphincter function in people with DS, is widely reported in the literature [13–18]. In their comparative study of 58 DS adults and 38 adults without DS, Zarate et al. [15] identified a higher prevalence of achalasia in the DS subjects, symptoms of which included dysphagia for solids and liquids, regurgitation, and chest pain. Esophageal motility problems can also lead to food loss, food refusal and gagging, [10], vomiting and gastroesophageal reflux [19], choking, difficulty progressing to more advanced textures, and increased risk of aspiration [20, 21].

Impact of Aging on Eating, Drinking, and Swallowing in the General Population

Although there is no current research that examines the effects of the aging process on EDS function in people with DS, there is a small body of knowledge on how the swallow changes with age in the general population. The normal aging process brings about several changes in the structure, strength, coordination, and sensitivity of the swallowing mechanism in healthy adults that can directly impact on EDS function [22–27].

After the age of 45, healthy adults begin to experience a gradual decline in skeletal muscle mass, strength, and efficiency, which applies equally to facial, masticatory, and lingual musculature [28–33]. An increase in connective tissue within the muscles of the EDS mechanism leads to stiffness, reduced mobility, and reduced flexibility [33–36] which results in a slower passage of the bolus through the oropharynx [26, 37]. Nicosia et al. [35] observed decreased lingual muscular strength and flexibility with aging, but at the same time the authors found no changes in older subjects' functional ability to maintain adequate tongue pressures for swallowing.

Similarly, a more recent study by Peyron et al. [38] found that although the number of chewing cycles and duration of chewing performed by healthy subjects increased progressively with age, there was no decline in the older subjects' functional ability to efficiently break down foods of different hardness. The authors suggest that older adults are able to adapt to age-related deterioration in jaw muscle mass and strength by working their jaw muscles to their maximum capacity, whereas younger individuals typically do not need to do so to achieve the same level of chewing efficiency. However several aspects of this study limit the interpretation of the findings. A recruitment bias toward younger subjects was evident, with only 13 of 67 adults over the age of 50. The method of drawing the sample could also have introduced bias, because it used only volunteers who read and responded to an advertisement in a local paper. There are many selection factors that determine which patients would have volunteered for the study such as socioeconomic level and health status that may make the sample unrepresentative of the general population.

Moreover, the cross-sectional research design interprets differences between the younger and older subjects as indications of developmental effects of aging on chewing skills. There may be many uncontrolled factors such as different life experiences and health factors that distinguished the older and younger subjects as they passed through their developmental stages. A longitudinal research design that studies randomly selected individuals over long periods of time would better represent the process of aging on the chewing mechanism.

Several studies identify age-related changes in the pharyngeal swallow. Reduced flexibility and strength of contractions of the pharyngeal wall [24, 25, 37, 39] and reduced lubrication of the pharyngeal mucosa [38] can lead to increased residue of food and drink, requiring the older adult to perform multiple swallows to clear a bolus from the pharynx [1, 34].

It is commonly reported that pharyngeal swallowing is delayed in healthy elderly subjects and that this may lead to a greater frequency of residue penetrating the larynx. However, most studies do not identify an association between age and increased incidence of laryngeal penetration [36, 37, 40, 41]. An exception is a recent study by Daniels et al. [42] that reports the incidence of laryngeal penetration significantly increasing with advancing age. Unlike the majority of previous studies that examine isolated swallows, this study examines sequential swallowing skills, which the authors argue is more representative of typical swallowing of liquids. The authors suggest that laryngeal penetration is characteristic of the normal healthy aging process and does not increase the healthy adult's risk of aspiration. This single cohort study comprised a sample of 38 adult men. A power calculation confirmed that the sample size chosen yielded a significant effect. The results of videofluoroscopy recordings and the Penetration-Aspiration Scale [43] also showed a high level of inter- and intrarater agreement, which confirmed validity and reliability of the findings. A limitation of the study is in the failure to provide information about selection criteria and whether the selection was randomized, which leaves considerable room for bias. With no information about how the subjects were recruited, it is not possible to determine the validity of the findings. In addition, by minimizing systemic bias by choosing all male subjects, the findings cannot be applied to females.

Other than age differences, Daniels et al. attempt to minimize differences between the subjects via inclusion and exclusion criteria. However, there are insufficient details provided about the methods and results of the oral-motor assessment that were used to set inclusion criteria. Without knowing whether the assessment was validated or whether interrater reliability was assessed, undetected differences in subjects' oral-motor skills are likely to significantly affect outcomes of the study.

Not unlike the study by Peyron et al. [38], the Daniels et al. study makes assumptions about the aging process of the swallow by comparing separate groups of young and older subjects. Again, a cohort study of randomized subjects over time would be a more effective way of examining the effects of the aging process on swallowing and it would also allow the researchers to estimate effects of confounding variables.

Several studies in the literature also report changes in swallow-respiration coordination with healthy aging. Earlier onset of cessation of respiration (swallowing apnea) and increased swallowing apnea duration are potential compensatory strategies for age-related slowing of the EDS mechanism [3, 44, 45]. In addition, some studies identified a higher occurrence of postswallow inhalation of pharyngeal residue in adults over the age of 65. However, overall coordination of the swallow and strength of the laryngeal cough were preserved, and occurrence of aspiration in healthy elderly persons was not different from that in younger subjects [3, 22, 24, 37].

Changes in esophageal physiology with aging have also been widely reported, including reduced esophageal sensation and changes in motility of the upper and lower esophageal sphincters [23, 46]. An increase in connective tissue in the upper esophageal sphincter (UES) and delayed UES opening [23, 39,

47] can impede smooth passage of the bolus and increase the amount of time a bolus is adjacent to an open airway [48].

The literature to date suggests that the aging process involves several anatomical changes to the EDS mechanism. However, aging *per se* reportedly has little functional impact on EDS, with healthy adults compensating effectively for these age-related changes by increasing functional output. Although aging of the EDS mechanism may pose no problems for the general population, older DS individuals may be unable to compensate for these changes given that, as previously suggested, they may already have EDS problems as a consequence of their syndrome.

In addition, the above studies have suggested that healthy elderly individuals use their muscles to their maximum capacity to maintain EDS skills. Because of this, older people have a diminished functional reserve such that they may be less able than younger people to cope in the face of stressors such as illness or disease and this may lead to dysphagia. The typical older person with DS is also likely to possess diminished functional reserve to a greater degree than the general population given the problems associated with their syndrome. This is likely to put them at an even greater risk of developing dysphagic difficulties than the general elderly population.

Although the natural aging process may not be directly responsible for causing dysphagia, swallowing problems in older persons are nonetheless common due to a higher prevalence of concomitant illnesses and chronic conditions in the elderly [49]. These include altered dentition, xerostomia, diabetes, arthritis, cognitive dysfunction, stroke, malignant disease, Parkinson's disease, amyotrophic lateral sclerosis, and dementia, all of which have been associated with coughing, choking, regurgitation, and difficulty initiating swallowing [3, 22, 23]. In addition, many of the medications prescribed for these conditions can also lead to dysphagia [50, 51]. Elderly adults with Down's syndrome are likely to be as much at risk of developing many of these age-associated conditions as the general elderly population. In addition, with several longitudinal studies confirming a premature aging process in DS adults, these conditions might also be observed at a much earlier age in people with DS [6, 52–54].

Alzheimer's Disease and Down's Syndrome

One clinical condition, dementia of the Alzheimer's type (DAT), merits particular attention because it is well recognized that aging adults with DS are at increased risk of developing DAT than is the general population [55]. Postmortem studies of the brain have revealed the presence of amyloid plaques and neurofibrillary tangles characteristic of DAT in virtually all DS adults over 40 years of age [56–59]. However, not all adults with DS develop the clinical symptoms of the disease and the reasons for this are currently unknown.

There is limited information about the incidence of DAT in adults with DS, and prevalence studies range considerably from 10% to over 75% [55, 56, 58, 60–65]. Zigman et al. [58] suggest several reasons for this wide variability, including differences in research methodologies, assessment and diagnostic procedures, confounding variables, and healthy survivor effects.

Tyrrell et al. [65] performed a cross-sectional study of 285 people with DS aged 35–74 years. Prevalence of DAT was 13.3%. The risk of developing DAT increased with advancing age, which is consistent with findings of other cross-sectional and population-based studies [62, 64]. The mean age of subjects at onset of DAT was 54.7 years, supporting the common view that DAT is an age-associated condition that develops earlier in adults with DS than in the general population [66].

Dysphagia occurs in virtually all patients with degenerative CNS diseases, including DAT, although the pattern of onset and the progression of oropharyngeal difficulties in adults suffering from DAT are currently not known [67].

In the general population, DAT causes serious impairments in motor function and coordination at both the oral and the pharyngeal phases [68], resulting in difficulties with self-feeding, chewing, initiating swallowing, managing oral secretions, nasal regurgitation, deterioration of the cough reflex, and choking [50, 67, 69]. These problems are well-documented in late-stage DAT [50] and often lead to aspiration [67, 70, 71] and aspiration pneumonia [1, 72, 73], which is a major cause of death in people with DAT [74, 75].

However, some authors report that swallowing problems can be the first symptoms to appear in DAT [74, 76]. Ikeda et al. [77] performed a prospective study examining eating, drinking, and swallowing changes in three groups of patients with frontotemporal dementia, semantic dementia, and DAT. The authors assessed for changes in appetite, food preferences, eating behaviors, and increased difficulties with swallowing, including choking, coughing, oral holding, and difficulty swallowing food and liquid. Unlike the other two groups, the DAT group appeared to develop swallowing prob-

lems early on in the course of the disease as a first or second identifiable symptom.

Similarly, Priefer and Robbins [50] examined independent-feeding and swallowing skills in ten early-stage DAT subjects and compared them with 15 healthy, age-matched control subjects. The group with mild-stage DAT required significantly more visual and verbal cues for self-feeding. Videofluoroscopic swallowing study revealed significantly longer oral transit times for solid food, pharyngeal response durations for liquids, and total swallow duration for liquids than in the healthy control subjects.

However, given the poor consistency of diagnostic techniques for DAT, it is possible that many of the subjects had the disease for longer than their diagnoses suggested; therefore, the results of these studies must be interpreted with caution.

As DAT progresses, latency of the swallow reflex is further affected. Wada et al. [67] examined swallowing function in 121 DAT patients. Initiation of the swallow reflex was significantly longer in patients with severe DAT than with mild to moderate DAT. Moreover, neuroleptic intake further prolonged mean latency of the swallow reflex.

There is a dearth of literature examining the effects of DAT on general EDS function in adults with DS. Only one recent longitudinal study by Prasher et al. [78] addresses the potential impact of dysphagia on DS adults with DAT by examining patterns of weight loss. Given that dysphagia is a cause of weight loss in the elderly with DAT [79], the findings of this study might suggest how EDS problems could influence weight loss in DS adults with the disease. The study compared two groups of 24 DS adults each, one group with DAT and the other without DAT. The subjects were age-matched, ranging in age from 41 to 60 years in each group. Both groups experienced unintentional and clinically significant weight loss over the five-year study. The DS subjects with DAT experienced a gradual and progressive weight loss of 20.8%, whereas for DS subjects without DAT there was a sporadic loss of 5.2%. The rate of loss between the two groups remained significantly different when factors such as age, gender, and cognitive ability were considered. The amount of weight lost in the DS patients with DAT is clinically significant in that epidemiologic studies in the general population associate increased mortality and morbidity with weight losses of 10% or more over a five-year period [79–81]. These findings are consistent with those of longitudinal studies in the general population without DS, in which individuals with DAT lost more weight more quickly than non-DAT individuals [82–84].

However, similar to the above studies the authors were unable to identify an underlying cause of the weight loss in both DS groups. It is therefore not possible to ascertain the role of dysphagia in this process. Although dysphagia in DAT may be a contributing factor, the authors and others acknowledge that additional factors such as reduced food intake, loss of appetite, difficulty with self-feeding, socioeconomic status, malabsorption of nutrients, side effects of medications, and concomitant medical conditions such as pneumonia and malignant disease may equally account for weight loss [79, 81, 85].

The fact that both the dementing and the nondementing DS groups experienced a clinically significant loss of weight also illustrates that factors other than DAT may influence weight loss in elderly DS individuals. Because the prevalence of dysphagia in adults with DS is unknown, it is difficult to ascertain how the observed weight loss might also be influenced by factors associated with the syndrome.

In the general population, a higher prevalence of weight loss is observed in the frail elderly over 65 years and in the very elderly over 75 years [80]. The observation of weight loss in a much younger group of DS adults in this study may support the view that people with DS experience weight loss associated with aging at a much younger age. However, further investigation into the potential underlying causes of this loss is needed.

Given the impact of DAT on EDS function and the increased prevalence of early-onset DAT in DS adults, additional longitudinal research is required to identify the progression, characteristics, and consequences of this disease on EDS function in the DS population.

Discussion

As the life expectancy of people with DS continues to increase, it is particularly important to understand the impact that the aging process has on EDS function in this population. Given the current lack of research in this area, this article has examined relevant literature to determine the importance of pursuing future research in aging and EDS function in DS.

Studies of pediatric and adolescent populations with DS have highlighted that from birth, people with DS have systemic and structural abnormalities and clinical conditions that may alter and impair EDS function. As children with DS develop, they experience ongoing physiologic and anatomical changes to the EDS mechanism that may require

them to adopt compensatory strategies to adapt to these changes. Although behaviors such as tongue protrusion have been suggested in the literature to interfere with EDS in many ways, it is also important that dysphagia practitioners consider how behaviors like this may represent ways in which people with DS attempt to compensate for their structural and anatomic limitations in order to eat, drink, swallow, and breathe as efficiently as they possibly can.

Studies on typical aging suggest that the natural aging process in DS alone may be sufficient to put healthy DS individuals at risk for dysphagia if the demands of age-associated changes exceed functional capacity. In addition, given that functional capacity decreases with age, it is likely that the risk for dysphagia will continue to increase as the person with DS gets older.

The most serious and common conditions suffered by elderly individuals are dysphagia and associated life-threatening conditions of pneumonia, malnutrition, and dehydration [33, 74]. In the general population, the incidence of pneumonia and mortality from aspiration pneumonia increases markedly in those over the age of 75 [74], and given the evidence supporting an accelerated aging process in people with DS, we may expect to see these same problems occurring in DS individuals as young as their 50s [86]. In addition, with other age-associated declines and illnesses as well as an increased prevalence of early-onset DAT in adults with DS, the risk for dysphagia and life-threatening sequelae are even further increased.

It is evident from this review of the literature that the aging process is likely to have significant effects on EDS function in people with DS; however, without specific evidence of these effects, practitioners are unable to ensure they are providing the best quality of care for people with DS and dysphagia. These effects would be better understood if longitudinal studies, using quantitative and qualitative measures, examined typical oropharyngeal function in DS subjects from birth over extended periods of time.

In current common practice, clients with DS may not be known to the dysphagia practitioner until they begin to experience dysphagic symptoms. The difficulties of many DS individuals to communicate effectively and self-report symptoms may also impede clinical evaluation and delay diagnosis of dyphagia.

Longitudinal research, however, may provide some evidence to promote regular baseline assessment of EDS skills in people with DS via procedures such as oral-motor skills checklists as part of their standard health screening, before dysphagic symptoms occur. This would further improve practitioners' skills in identifying warning signs early on and at specific developmental stages such as the transition from childhood to adolescence, adolescence to early adulthood, or approaching later adulthood, and also in distinguishing normal age-related changes from pathologic changes.

The author is currently part of a team proposing a prevalence study of dysphagia in adults with intellectual disability. Data from this will allow further detailed examination of the prevalence of EDS disorders in adults with DS. Case control studies are also currently being considered, using analysis of retrospective data to compare EDS function in younger and older adults with DS and without DS.

In terms of dysphagia management, translation of such research into clinical practice could encourage a shift from a reactive approach, where dysphagia might not be identified in the early stages but only once obvious dysphagic symptoms occur, to a more proactive approach, in which a clinician can draw on evidence from the literature to develop more effective and potentially preventative therapeutic approaches and clinical outcomes specific to the aging population with DS.

While there is a growing awareness that people with DS have the right to the same level of medical care and services as the general population, they may be unable to access these services largely because of a lack of understanding about how certain conditions affect the aging person with DS and how they can be best managed. Given the lack of robust evidence in the literature, it is currently possible only to speculate about how aging and age-associated conditions like DAT might influence EDS function in DS. However, from what information is available, it is clear that several factors are likely to impinge on EDS skills in the aging person with DS much earlier in life than in the general population. Longitudinal research studies that examine EDS across the lifespan of DS individuals are essential to develop understanding of this issue, to influence clinical practice to improve medical care and general health, and to enhance quality of life for people with DS.

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