DEVELOPMENT AND VALIDATION OF THE SWALLOW ABILITIES SCREENING QUESTIONNAIRE FOR THE INDIAN ELDERLY (SASQ-IE)

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CERTIFICATE

This is to certify that this dissertation entitled **"Development and Validation of the Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE)"** is a bonafide work submitted in part fulfilment for the degree of Master of Science (Speech-Language Pathology) of the student Registration number P01II21S0038. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru
September, 2023

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DECLARATION

This is to certify that this dissertation entitled **"Development and Validation of the Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE)"** is the result of my own study under the guidance of Dr. Swapna N, Head of Department of Clinical Services and Coordinator of Center for Swallowing Disorders, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for award of any other Diploma or Degree.

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CHAPTER I

INTRODUCTION

Ageing can be defined as the time-related deterioration of the physiological functions necessary for survival and fertility (Gilbert, 2000). The ageing process encompasses various changes across cellular, tissue, and whole-body levels, leading to decreased function, an increased risk of illness, and, ultimately, death. These changes are attributed to 'growing older' and are considered typical in the life of every human being. The effects of ageing are universal across all members of a species, and the maximum life span of a human is estimated to be about 121 years (Arking, 1998). As people age, there is a degeneration in the anatomy and physiology of the various systems in the body including the nervous system, which can cause deterioration in various functions including swallowing.

'Presbyphagia' or 'presbyglutition' is the name given to describe an ageing swallow. It is a well-established fact that the ability to swallow deteriorates with age (Walshe, 2019). Characteristic changes in the swallowing physiology of an older adult, who is otherwise healthy, is called Presbyphagia (Robbins et al.,1992). Presbyphagia is not the same as dysphagia as it is considered as the expected changes in swallowing that are seen during the process of ageing. Whereas, dysphagia is a swallowing disorder that can occur at any age and is most often secondary to diseases such as head and neck cancer, brain injury or other neurological insults to the body. Presbyphagia can often be a pre-clinical condition to dysphagia.

According to Robbins et al. (1992), individuals over 60 years of age may experience changes in swallowing due to various factors such as oral health status, chronic dry mouth, dentition, taste and cognitive status that affect eating and drinking

(Burda, 2011). With increase in age, there is a decrease in muscle mass and elasticity and an increase in fat within muscles (sarcopenia) which results in a loss of strength, range, speed, and accuracy of movement of the structures involved in swallowing (Hamrick et al., 2016; Walston, 2012). The overall range of motion of the muscles required for swallowing is reduced (Logemann et al., 2002). Similar changes are also seen in the central and peripheral nervous system. The motor control, central processing of swallowing and sensory feedback can degenerate as a person gets older (Baijens et al., 2016; Molfenter et al., 2018; Namasivayam-MacDonald, Barbon, & Steele, 2018). The brain areas responsible for processing sensory information experience decreased activity and degeneration. Both sensory and motor nerves have reduced speed of transmission and there is a decrease in neurotransmitters, which leads to disruption in the feedback loop between the sensory and motor areas (Weismer & Liss, 1991).

As a consequence, to these changes, several swallow related issues are seen. Slower movement of the bolus and decreased hyolaryngeal excursion has been reported which increases the instances of aspiration (Kagaya & Inamoto, 2022). Higher multiple swallows to clear the bolus were also seen in older adults when compared to middle and younger adults (Nilsson et al., 1996). Older adults had reduced peak suction pressure, reduced bolus volume, longer feeding intervals, reduced swallowing capacity and coughing (Burda, 2011). Dietary and food consistency changes, reduced food consumption (Sheikhany et al., 2022) and avoidance of certain food items were also seen which might then have a deleterious effect on their nutritional status. Hence it is important to identify such problems at the earliest.

As the ability to swallow efficiently diminishes with age, individuals might encounter difficulties in adequately nourishing themselves, leading to potential malnutrition and dehydration. Consequently, their overall health and vitality can be

compromised, affecting energy levels, immune function, and the ability to perform daily tasks. Moreover, the social and psychological dimensions of life are not immune to the effects of presbyphagia. Sharing meals with loved ones or engaging in communal dining can become sources of stress and anxiety due to fears of choking or embarrassment. The cumulative impact of these challenges can result in social isolation, diminished self-esteem, and an overall reduced quality of life. Recognizing the far-reaching consequences of presbyphagia underscores the importance of early intervention, adaptive strategies, and supportive environments to enable individuals to navigate these changes while maintaining their overall well-being and participation in life's activities.

Mehraban- Far et al. (2021) examined the effects of ageing and co-morbid factors on swallowing in the elderly and found that presbyphagia was the most common factor causing dysphagia in the oldest old cohort (>85 years old). The study also revealed that ageing caused an increase in oral time transit (OTT) and aspiration after swallowing. Walshe (2019) in their study attempted to describe the evidence of the changes seen in swallowing that were linked to normal ageing and found differences in the oral phase, pharyngeal phase as well as esophageal phase of the swallow. These studies highlight the significance of identifying swallow issues early in the older adults in order to initiate intervention at the earliest.

Various tools have been developed and utilized in the identification or screening of swallowing difficulties over the years. Screening is a method intended to identify any signs of difficulty swallowing or risk of aspiration (Jiang et al., 2016). Tools such as the Eating Assessment Tool-10 (EAT-10) by Belafsky et al. (2008), the Sydney Swallow Questionnaire (SSQ) developed by Wallace et al. (2000), The Volume-Viscosity Swallow Test (V-VST) designed at the Hospital de Mataró, Catalonia, Spain, in 2005, Gugging Swallowing Screen (GUSS) by Trapl et al (2007)and Simple

Standardized Bedside Assessment of Swallow by Perry (2001) among many others have been developed and validated to screen for dysphagia, but very little evidence prevails on the efficacy of these tools in screening of swallowing function specifically for the healthy elderly.

A few studies employed the existing tools, such as the GUSS to identify oropharyngeal dysphagia in older adults in hospitals with no secondary dysphagia and proved to be a reliable and valid procedure for the same, albeit, it was not designed to identify the subtle changes in swallowing that are characteristic of presbyphagia(Umay et al., 2019). A screening questionnaire that is essentially designed to detect the changes that differentiate the 'normal' ageing changes in swallowing from the disordered swallow would help in the intervention and management strategies for presbyphagia. A study by Garand et al. (2020) aimed to examine whether the EAT-10 was able to detect the subtle changes of swallowing due to ageing. They concluded that EAT-10 was not sensitive enough to detect changes in swallowing due to ageing.

In the recent past, attempts have been made to develop screening tools for the screening of dysphagia in healthy older adults. One such tool is the Dysphagia Risk Assessment Scale (DRAS) by Fukuda et al. (2002). It is a 17- item self-administered questionnaire, which was developed to help detect elderly who are at risk of dysphagia. This tool was developed by conducting structured interviews on 2,508 individuals. The 3-ounce water swallow test given by DePippo et al (1992) was administered on 90 individuals as the gold standard. A retest was administered on those 90 individuals after about one to two months. A factor analysis was done and four factors were extracted and the reliability measure showed poor retest reliability on factors 1 and 2 (Factor 1: Aspiration, Factor 2: Poor pharyngeal clearance). Since, it is a self- administered scale, the low test- retest reliability scores were believed to be due to the lack of realization and awareness of symptoms such as aspiration that occur before, during and after

swallow and pharyngeal clearance in the elderly individuals. Thus, the sensitivity was slightly lower. This test also does not take into account the oral health-related factors such as use of dentures or missing teeth, that are common with ageing (Fukuda et al., 2002).

The Dysphagia Risk Assessment for The Community-Dwelling Elderly (DRACE) is another tool for assessing the risk of dysphagia in healthy elderly, developed by Miura et al (2007). It is an 18-item tool to assess the likelihood of difficulties with chewing and swallowing in older adults. This tool has taken into account even the masticatory abilities in the elderly and hence provides more information on ageing-related changes. The sample size used in this study was small (85 participants) compared to other studies. Although it is easy to administer, it has shown low accuracy and reliability (Chen et al., 2022).

The Dysphagia Manifestations Questionnaire is another screening questionnaire developed by Sheikhany et al. in (2022). It is developed in the Arabic language and consists of 14 questions related to difficulties faced by the elderly during swallowing. This tool can be administered by caregivers and other professionals. However, this questionnaire takes longer time to administer when compared to other screening tools and shows strong results only when administered alongside with a bedside screening evaluation. The questionnaire is not recommended to be used as a stand-alone screening tool for evaluating the risk of dysphagia in older healthy adults (Sheikhany et al., 2022).

1.1 Need for the study

Speech-language pathologists (SLPs) majorly depend on inpatient or outpatient screening procedures, so the community-dwelling elderly population can often be left unnoticed. Studies comparing the swallow of healthy young vs. older adults have exhibited various changes that are related to ageing (Logemann et al., 2002; Shaw et al., 1995; Tracy et al., 1989). In a study conducted in India, better swallowing efficacy

in younger individuals when compared to older individuals was seen, and they emphasize the need to take into account the effects of ageing when making a diagnosis and providing rehabilitation for older adults (Mehjabeen et al., 2021). Oral health problems also contribute to the risk of malnutrition in older adults Although, these problems persist, healthy elderly individuals do not complain of difficulty in swallowing as they believe that these are the natural changes seen during ageing and are unaware that these difficulties can be managed with the support of speech-language pathologists.

The literature review on the current screening tools indicates that the tools currently available for the screening of presbyphagia are falling behind on the purpose of accurate screening due to poor reliability results, smaller sample size and inability to be used as an independent screening tool. Moreover, there have been no tools developed in the Indian context. Studies have reported differences in anatomical structure, foods consumed, the extent of spices used, cooking styles, cutlery used, the meal frequency and duration etc. across persons in different parts of the world (Ketel et al., 2020; Xue & Hao, 2006), which might affect the swallow function. There is a need for tools specific to each ethnic group. A few studies have shown that poor oral health in Indian elderly population is associated with nutritional deficits (Kshetrimayum et al., 2012) and thus there is a need to develop a screening questionnaire that includes all phases of swallowing specific to the Indian context.

The World Health Organization (WHO) presented a Report on Ageing and Health in 2015, which states: “To meet the needs of ageing population, significant changes are required in the way health systems are structured, and healthcare is delivered. In many places, particularly in low- and middle-income countries, access and affordability, are key barriers to care. New services and approaches will need to be developed in these settings.” (Namasivayam-MacDonald et al., 2018). The WHO, along

with many stakeholders and partners across the globe, culminated in The United Nations Decade of Healthy Ageing (2021–2030), which brings together governments, civil society, international agencies, professionals, academia, the media, and the private sector to improve the lives of older people, their families, and the communities in which they live (WHO, 2021). The screening questionnaire for early identification of swallow problems in the older adults will be a step towards achieving this objective.

The need for a screening questionnaire to assess and detect presbyphagia is of necessity because it would help in planning intervention programs specific to the symptoms associated with difficulty in swallowing in these individuals, and that, in turn, would facilitate the older individuals to lead a better life. A plethora of studies have exhibited that swallowing training using specific swallowing techniques can promote a change in swallowing in robust older adults (Burda, 2011). For example, lingual resistance exercise slightly elevated the isometric and swallowing pressures in a set of healthy elderly (Robbins et al., 2005). Shaker exercise (Shaker et al., 1997) also demonstrated better swallowing function in about half of the healthy elderly participants (Burda, 2011). Hence, to provide better rehabilitation for older adults, it is vital to detect the presence of presbyglutition as the first step. Owing to our role as SLPs in the enrichment of the lives of older adults, it is necessary to construct a tool which would aid in the effective description and recognition of swallowing problems associated with ageing.

1.2 Aim

The aim of the study is to develop and validate a questionnaire-based screening tool to identify diminished swallowing abilities in healthy older adults in the Indian context.

1.3 Objectives of the study

1) To develop a questionnaire-based screening tool to identify diminished swallowing abilities in healthy older adults.

2) To determine the content validity of the questionnaire

3) To assess the construct validity of the questionnaire.

4) To determine the reliability of the questionnaire.

CHAPTER II

REVIEW OF LITERATURE

Presbyphagia, the age-related decline in swallowing function, is a significant concern among the elderly population. As individuals age, various physiological changes occur in the oropharyngeal structures and swallowing muscles, which can affect the efficiency and safety of swallowing. This review aims to explore the current literature on swallowing issues in the elderly, the assessment methods employed in the evaluation of presbyphagia, highlighting their strengths and limitations.

As older adults anticipate longer retirements and seek to engage in social activities involving eating and drinking, it is ironic that they experience anatomical and physiological transformations that heighten the likelihood of swallowing difficulties as they age. This situation is further compounded by the fact that the loss of swallowing function can have severe health consequences, such as inadequate nutrition and hydration, compromised overall health leading to conditions like pneumonia, and increased demand for caregiving, particularly among the elderly (Ney et al., 2009). With the ageing world, it is necessary that practicing clinicians are able to identify and distinguish between dysphagia and presbyphagia to avoid situations of over-diagnosing or over-treating dysphagia (Ney et al., 2009).

2.1 Normal swallowing

To understand the swallowing changes that come along with ageing, it is important to first apprehend the normal process involved in a healthy swallow and its different phases. Typically, swallowing proceeds as a well-organized physiological function that moves food and saliva from the mouth to the stomach (Miller, 1982). The act of swallowing appears deceptively simple and easy, but in reality, it involves a highly intricate neuromuscular system that skillfully coordinates and executes the entire

swallowing sequence. In most cases, swallowing is seen as a voluntary action since it can be initiated consciously by simply thinking "swallow." However, numerous swallows, especially those that happen outside of mealtime, occur automatically without conscious control. When eating, the process of swallowing is linked to a rise in salivation, which aids in triggering the swallowing reflex and acts as a lubricant to facilitate the smooth passage of food (Dent et al., 1988).

2.2 Phases of swallowing

According to most researchers (Dodds et al., 1988), swallowing is divided into three phases- 1) Oral Phase 2) Pharyngeal Phase 3) Esophageal phase. In a study by Dodds et al., (1988), they describe the phases of swallowing and state that the process of swallowing can be broken down into several distinct phases. In the preparatory phase, the bolus (chewed food) is mixed with saliva through mastication, and it is shaped, sized, and positioned on the tongue in preparation for swallowing. During the oral phase, the tongue propels the bolus from the mouth into the pharynx. In the pharyngeal phase, the bolus is transported from the oropharynx (the back of the mouth) into the esophagus without any risk of aspiration (entry into the airway). Finally, during the esophageal phase, the bolus is propelled through the entire length of the esophagus and into the stomach.

2.2.1 Oral Phase of Swallowing

During the oral phase, the tongue performs a squeezing motion, similar to how one squeezes a tube of toothpaste, to push and hold the bolus between the tongue and the palate (Hiiemae et al., 2003). In a study by Hiimae et al., (1978) they describe how the bolus is pushed towards the back of the mouth, close to the opening of the pharynx. The oral phase seamlessly combines the actions of ingestion and chewing, enabling the oral cavity to perform multiple motor functions aimed at reducing the food into a size that can be safely swallowed through the pharynx and esophagus. This intricate

interplay of various motor responses demands extensive sensory feedback and precise coordination from the central nervous system. The different cortical regions controls the brainstem regions, which contain groups of interneurons (known as central pattern generators), responsible for orchestrating sequences of motor neuron recruitment in various cranial motor nuclei during chewing and pharyngeal swallowing.

The oral phase of swallowing involves a sophisticated series of motor movements that coordinate the actions of the tongue, mandible (lower jaw), and hyoid bone (a bone in the neck). This phase is just one part of a sequence of oral movements, which include cutting up food, moving it across to the back teeth, chewing the food to reduce it into tinier pieces, and subsequently moving these small boluses towards the oropharynx through squeezing-like actions of the tongue against the palate (Hiiemae et al., 1978).

Shaker et al. (2012) explained that the different movement patterns involved in the oral phase of swallowing are carefully coordinated to achieve two main objectives: Chewing: The initial movements, including incising and masticating, aim to break down the food into smaller, more manageable pieces or boluses.

Manipulating and Transporting: Once the food has been reduced to smaller boluses, the tongue's squeezing-like actions against the palate facilitate the posterior movement of these boluses toward the pharynx, where the next phase of swallowing continues. This allows for efficient transport of the chewed food from the mouth to the pharynx for further swallowing and passage into the esophagus.

2.2.2 Pharyngeal Phase

The findings of Kahrilas et al. (1993) point out that during the pharyngeal phase of swallowing, the bolus is transported through the pharynx and into the esophagus. Importantly, the normal respiratory function of the pharynx pauses during this phase to prevent any aspiration of food or liquids into the trachea and lungs. This prevention is

achieved through the coordinated activity of muscles surrounding the pharynx. As the pharynx elevates, it closes off the airway and then contracts in a peristaltic manner to propel the food in a caudal (downward) direction, ensuring that it moves towards the esophagus and not into the air passages. This process effectively protects the respiratory system while allowing for safe and efficient transport of the swallowed material into the digestive system.

Dodds et al. (1990) in his study examining the physiology and radiology of the normal oral and pharyngeal stage of swallowing describes how upon reaching the oropharynx, the bolus experiences a swift, piston-like movement of the posterior tongue, propelling it rapidly from the oropharynx into the hypopharynx. The posterior chamber of the posterior lingual piston is created by the posterior pharyngeal wall, which becomes rigid due to the sequential contraction of its three constrictor muscles. As the bolus enters the pharynx, the front part of the bolus moves faster than the tail, causing elongation of the bolus within the pharynx. This elongation exerts a force that aids in the opening of the upper esophageal sphincter (UES), and consequently, the bolus quickly enters the proximal esophagus. The UES opens normally in a liberal and unrestricted manner during this process. In their study they also list several crucial events occur in this phase such as:

a) Palatal closure.

b) Bolus transfer through the pharynx.

c) Glottal closure to prevent aspiration into the airway.

d) Opening of the UES, allowing for the flow of fluid from the pharynx into the esophagus.

2.2.3 Esophageal Phase

Kahrilas et al. (1988) examined the upper esophageal sphincter function during swallowing and stated that the esophagus is separated from the pharynx by UES and

from the stomach by the lower esophageal sphincter (LES). The opening of these sphincters is precisely coordinated to occur as boluses of food and water reach them. The UES, also known as the pharyngo-esophageal sphincter, is typically in a closed state and then relaxes during pharyngeal swallowing to allow the bolus to pass from the pharynx into the esophagus. After the bolus moves caudally (downward) in the esophagus towards the stomach, the UES closes again to prevent any regurgitation of stomach contents back into the throat. This coordinated and timed action of the sphincters ensures proper food movement through the digestive tract and helps prevent reflux and aspiration.

The strength of the peristaltic contraction during swallowing is influenced by sensory feedback, which becomes apparent when food is present in the mouth. The volume of the bolus, or the amount of food being swallowed, can impact the muscular contraction during the pharyngeal phase, leading to an increase in the intensity of the esophageal contraction. In simple terms, the larger the bolus, the more robust the muscle contractions in both the pharynx and esophagus, facilitating the smooth and efficient passage of the food through the digestive system (Shaker et al., 2012).

2.3 Ageing Swallow

The act of swallowing, a fundamental function sustaining life, undergoes a remarkable journey of change as individuals advance in age. This intricate process, reliant on a delicate interplay of physiological and anatomical elements, holds crucial significance beyond its apparent simplicity. As time unfolds, the once seamless orchestration of muscles, nerves, and structures that facilitate swallowing undergoes shifts that can reverberate across various aspects of life. The convergence of physiological and anatomical changes intertwines with the daily experiences of individuals, influencing not only their nutritional intake, but also their overall quality of life. In the following discourse, we delve into the nuanced transformations that occur

within the realm of ageing swallowing, examining their multifaceted implications, shedding light on the intricate interrelationship between the human body and the passage of time.

Elsner (2002) reviewed the changes in eating behavior that comes along with ageing and understood that as individuals grow older, it is possible for the efficiency of their gastrointestinal systems to decline (Shamburek & Farrar, 1990). Consequently, adjustments in the quantity or quality of the foods consumed may become necessary. This not only involves changes in the amount and types of food consumed, but also in the nutrients obtained. Additionally, older individuals may experience changes in their attitudes and thoughts about food.

2.3.1 Ageing effects in the Oral phase of swallow

Studies have shown that age-related changes include those such as decreased sensation in the mouth, reduced taste and smell, tooth loss, lower production of saliva (hyposalivation), and the sensation of dryness in the mouth (xerostomia) that have an effect on the oral stage of swallowing. A study by Smith et al in 2006 was conducted to investigate how well individuals without any specific oral or pharyngeal issues can sense the thickness of liquids in their mouth and throat. The study also aimed to identify whether there are any differences in these perceptions between different age groups among the general adult population. The study involved sixty individuals who were considered healthy volunteers and ranged in age from 21 to 84 years. The findings revealed that the exponent for perceiving the thickness of liquids in the mouth was 0.3298, and for perceiving the thickness in the throat and oropharynx was 0.3148. The ability to sense viscosity declined as age increased. Moreover, men showed a more significant decline in sensitivity compared to women.

On the other hand, a study done by Calhoun et al. (1992) to assess oral sensation

in 60 healthy adults in five age categories from age 20 to above the age of 80 years revealed that thermal, somesthetic, and proprioceptive sensitivity did not exhibit any significant changes with age and the ability to differentiate tactile and vibratory sensations on the lip decreased after the age of 80. However, there was no change observed in vibration detection on the soft palate. Up to the age of 80, the ability to recognize objects by touch (stereognostic ability) remained strong. However, after this age, there was a decline in the ability to correctly identify four out of the nine tested shapes. Overall, the research noted that oral sensation maintained its effectiveness throughout ageing, with only a slight decline in function occurring after the age of 80.

Literature has revealed that the rate at which saliva is produced can have an impact on how a bolus (a mass of food) is sensed and handled during swallowing. As individuals get older, their saliva production decreases. Although medication is a major contributor to reduced saliva production and the sensation of dry mouth (xerostomia), the decline in salivary flow among older adults seems to be unrelated to medication usage, specific diseases, or treatments for those diseases (Walshe, 2019). This finding was observed in a study done by Rogus-Pulia et al in 2018 who intended to study the relationship between mouth dryness and advancing age. The findings suggested that as people grew older, they tended to experience an increased sensation of dryness in the mouth. However, the perception of the effort required for swallowing did not change with age. Irrespective of age, individuals who felt greater dryness in the mouth also reported higher levels of perceived effort when swallowing, indicating that sufficient oral lubrication might play a part in this perception. Interestingly, even among healthy participants, using a gel-based saliva substitute reduced the perceived effort required for swallowing. This suggests that maintaining adequate oral moisture can influence the perception of swallowing difficulty, and the use of such substitutes can alleviate this sensation. These results align with findings from other research studies (Lee, Kim, &

Moreno, 2016; Matear & Barbaro, 2005), which also indicate that medication usage and the presence of multiple medications (polypharmacy) are factors associated with reduced saliva production. The outcomes of decreased salivary flow encompass heightened exertion during chewing and handling of solid food particles, alongside a diminished ability to taste and a tendency to avoid specific types of foods.

Among experts, there is a widely accepted agreement that the strength of the tongue tends to diminish as a person ages and is a gradual change over time during the oral phase of swallowing. Ney et al in 2009 cumulated the findings from previous studies and investigated the effects that age has on swallowing and lingual pressure. The research has highlighted that changes in lingual pressure generation contribute to presbyphagia. Healthy older individuals exhibit notably lower static tongue pressures compared to their younger counterparts. However, the maximum tongue pressures generated during swallowing, which are essential for a successful swallow, remain at normal levels. Although older individuals can generate the necessary pressures for adequate swallowing despite reduced overall tongue strength, they do so at a slower pace than younger individuals. The swallowing process in healthy older individuals tends to be slower. This extended duration primarily occurs before the automatic pharyngeal phase of swallowing is initiated.

A study by Butler et al. in 2011 where the researchers put forth a hypothesis that among older adults without health issues, those who inhale foreign substances into the airway (aspirate) will exhibit lower levels of tongue strength compared to their counterparts who do not experience aspiration. Additionally, since muscle weakness could be indicative of a broader age-related impact, the study delved into whether there is a correlation between tongue strength and handgrip strength. They evaluated a group of 78 older adults living independently in the community, with an average age of 77.3 years and a standard deviation of 7.26 years. They determined their status regarding

aspiration, with 37% of the participants identified as aspirators, through the use of flexible endoscopic evaluation of swallowing (FEES). They measured various aspects of tongue strength, including maximal isometric strength of the anterior and posterior parts of the tongue, as well as the strength used during swallowing for both anterior and posterior tongue movements. Additionally, they measured their maximum handgrip strength. Results indicated that among the participants, individuals who aspirated (inhaled foreign substances into the airway) had significantly lower isometric tongue strength in comparison to those who did not aspirate. This difference was statistically significant ($p = .03$) for both the front of the tongue (463 mmHg in aspirators vs. 548 mmHg in non-aspirators) and the back of the tongue (285 mmHg in aspirators vs. 370 mmHg in non-aspirators). Similarly, swallowing tongue strength was also notably lower in aspirators compared to non-aspirators at both the anterior (270 mmHg in aspirators vs. 317 mmHg in non-aspirators) and posterior lingual locations (220 mmHg in aspirators vs. 267 mmHg in non-aspirators). Despite these differences in tongue strength, there was no significant disparity in handgrip strength between aspirators and non-aspirators ($p > .05$). However, it is worth noting that handgrip strength did show a correlation with posterior tongue strength ($r = .34$, $p = .005$), indicating a relationship between these two factors.

Another study by Vanderwegen et al. (2013) where they analysed the maximum anterior and posterior tongue strength and endurance across ages. The Iowa Oral Performance Instrument (IOPI) was utilized to measure various aspects. Individuals aged over 70 displayed notably reduced tongue strength compared to younger individuals, both in the front and back of the tongue. However, endurance remained relatively consistent throughout most of one's lifespan. Gender had a noticeable but not major impact, with males exhibiting higher pressure levels and longer endurance. The front part of the tongue showcased greater strength and endurance compared to the back

part. Notably, the average maximum tongue pressures in this European population were lower than those recorded in American studies and more closely resembled outcomes seen in Asian populations. Additionally, the atrophy of the geniohyoid muscle was identified as being linked to aspiration among healthy older adults (as discussed in Feng et al., 2013).

There is an ongoing debate about how measurements of tongue pressure on tasks not involving swallowing might differ from those during swallowing tasks. Even variations are noted between different types of swallows, such as saliva and water. Fei et al. (2013) discovered that although maximum isometric tongue pressures were reduced in an older adult cohort (aged over 60 years), the pressures exerted during saliva and water swallowing were not affected by age. This suggests that the impact of age on swallowing biomechanics might be more related to the type of bolus (substance being swallowed) rather than solely the age factor itself. This viewpoint is also supported by previous research (Fei et al., 2013; van den Engel-Hoek et al., 2012).

In addition to the decline in tongue strength, there is also a noted reduction in the strength of masticatory (chewing) muscles, as highlighted in studies by Hara et al. (2018) where they stipulated the association between the strength of the muscles of the tongue and masticatory muscle strength and the correlation between the tongue pressure and maximal occlusal force were investigated. Findings conclude that both ageing and factors related to Maximum Oral Function (MOF) have been linked to changes in tongue pressure among both older adults and younger patients. The decline in tongue pressure that occurs with age can potentially be mitigated by regularly engaging in lingual exercises, even prior to reaching old age. Furthermore, the deterioration of MOF might serve as an indicator of reduced tongue pressure among the elderly population. A previous study by Machida et al. (2017) investigated the impact of both ageing and sarcopenia on two key factors: tongue pressure and jaw-opening force. The aim was to

understand how these two factors are influenced by the ageing process and the presence of sarcopenia, which is the age-related loss of muscle mass and strength. The study included a total of 197 older adults, comprising 97 men with a mean age of 78.5 ± 6.6 years and 100 women with a mean age of 77.8 ± 6.2 years. The classification of sarcopenia was determined using the Criteria of the Asian Working Group for Sarcopenia. To discern the significant independent factor between ageing and sarcopenia that impacts tongue pressure and jaw-opening force, the researchers conducted a multivariate linear regression analysis. The study revealed the following results: The average tongue pressure was 26.3 ± 7.8 kPa in men and 24.6 ± 7.2 kPa in women. The average jaw-opening force was 6.3 ± 1.6 kg in men and 5.2 ± 1.3 kg in women. For men: Tongue pressure, ageing, and sarcopenia were identified as significant independent variables affecting tongue pressure. Jaw-opening force and sarcopenia were significant independent variables affecting jaw-opening force. For women: Only sarcopenia was identified as a significant independent variable affecting tongue pressure. Neither ageing nor sarcopenia were significant independent variables affecting jaw-opening force. These results suggest that in men, both tongue pressure and jaw-opening force are influenced by a combination of factors including tongue pressure, ageing, and sarcopenia. In women, however, only sarcopenia appears to significantly impact tongue pressure, and jaw-opening force is significantly influenced by jaw-opening force and sarcopenia.

With regards to dentition, Yurkstas et al. in 1964 conducted a controlled trial that revealed individuals with a higher number of teeth, when compared to age-matched older individuals, exhibited more efficient chewing. Conversely, those with a smaller number of teeth experienced reduced masticatory efficiency (16%-50%), resulting in longer food retention in the mouth. The prevalence of root caries in individuals aged over 60 is twice as high as in younger individuals, with 64% and 96% of those aged

over 80 experiencing root and crown caries, respectively. When the neurovascular structures in the dental pulp are affected, teeth can become sensitive, painful, and prone to infection (i.e., bacteremia). Consequently, individuals may reduce their intake of vegetables, fruits, and nuts, thereby impacting their nutritional status. Therefore, individuals without teeth are more likely to experience weight loss and malnutrition (Feng et al., 2023)

2.3.2 Ageing effects in the Pharyngeal phase of swallow

Majority of the studies examining the pharyngeal phase of swallowing has reported that swallowing is slower in older adults when compared to younger ones such as the study done by Tracy et al. (1989) which highlight several statistically significant effects associated with increasing bolus volume and age such as: Oral transit of the bolus head decreased, duration of cricopharyngeal opening increased and with increasing age, duration of pharyngeal swallow delay increased, duration of pharyngeal swallow response decreased, duration of cricopharyngeal opening decreased, peristaltic amplitude decreased, peristaltic velocity decreased. These results indicate that as bolus volume increases, effects on oral transit and cricopharyngeal opening are observed. Additionally, with increasing age, changes are seen in various aspects of the swallowing process, such as delays in pharyngeal swallow, alterations in cricopharyngeal opening duration, and reduced peristaltic amplitude and velocity.

Certainly, the act of drinking through a straw and performing sequential swallows can be affected by the ageing process, as observed in the study by Daniels et al. (2004). In their study, videofluoroscopy was utilized to observe two separate 10-second trials of straw drinking in a group of 20 young, healthy men with an average age of 29±3 years, and 18 older, healthy men with an average age of 69±7 years. The study focused on analyzing movement patterns of the hyolaryngeal complex (HLC), the initial bolus location during swallowing, and instances of airway invasion. Two distinct

HLC patterns emerged from the analysis: (a) a pattern where the HLC lowered with the epiglottis returning to an upright position between swallows, and (b) a partially sustained HLC elevation with the epiglottis inverted between swallows. Notably, the bolus was frequently located in the hypopharynx at the onset of swallowing. Noteworthy correlations were observed between age and HLC pattern, age and bolus location, as well as HLC pattern and bolus location. While laryngeal penetration occurrences were infrequent overall, they were more prevalent among the older participants compared to the younger ones. A noteworthy connection was established between age and the average score on the Penetration-Aspiration Scale, which evaluates airway invasion severity. Additionally, laryngeal penetration was linked to both HLC movement patterns and the position of the bolus in the hypopharynx, particularly in older adults. The findings suggest that subtle variations related to age manifest in the straw-drinking behavior of both healthy young and older adults. This implies that specific inherent swallowing patterns might elevate the susceptibility to laryngeal penetration as a part of the natural ageing process. This observation holds significant implications for the elderly population. Many older individuals might be advised to utilize straws as a means of compensating for diminished hand functionality and challenges in gripping cups and drinking glasses.

Ekberg and Feinberg in 1991 evaluated 56 individuals with an average age of 83 years who did not experience any symptoms of dysphagia (difficulty swallowing) or eating difficulties. Videofluoroscopy (a type of X-ray imaging) and radiographs were conducted with the subjects both standing and lying down. The aim was to assess their swallowing function. Only 16% of the participants demonstrated normal deglutition (swallowing) patterns similar to those seen in younger individuals. Pharyngeal dysfunction was observed in 25% of the participants. This included issues such as bolus retention (food remaining in the throat), problems with lingual propulsion (movement

of the tongue) or pharyngeal constrictor paresis (weakened muscle contractions in the throat). Approximately 39% of the participants had abnormalities in the pharyngoesophageal segment, primarily involving dysfunction of the cricopharyngeal muscle (located at the upper end of the esophagus).

An investigation on the oropharyngeal phase of swallowing was carried out in different age groups by Robbins et al in 1992. In the study they recruited 80 normal subjects and divided them into different age groups and swallow trials were given with liquid and semisolid food consistencies and the swallowing function was recorded using videoflouroscopy and manometry. The findings suggested that various parameters were different for different age groups and changes significantly as age increased. They reported a difference in the total duration of the oropharyngeal swallowing, which was the longest in the oldest age group. The longer durations with increasing age were mostly caused by a delay in the onset of peak hyolaryngeal excursion. Additionally, it was discovered that the bolus consistency and the presence or absence of the manometry tube affected durational changes significantly. The UES opened for longer time in females. Age, gender, or consistency of bolus did not substantially affect the amplitude of pharyngeal pressures, length of peak pharyngeal pressures, or pace of propagation of the contractions. They concluded that although some features of swallowing are impacted, some do remain intact.

Logemann et al. (2002) aimed at recognizing and identifying whether ageing effects of swallow were seen in older women. For this study, eight young women aged 21 to 29 and eight women aged 80 to 93 were recruited. Two swallows were assessed, one with 1ml and the other with 10ml liquid consistency. Videofluoroscopy was used to record the swallowing and kinematic analysis was carried out. This kinematic study provided information on the range of motion of the pharyngeal structures and the coordination of the oropharyngeal swallow. Larynx position during repose and neck

length were compared between the two groups. Data from this study were contrasted with older and younger men's previously published data. It was interesting to note that the range of motion of older women was frequently larger than that of the younger women. Only the base of the tongue moved substantially less as women aged. Similar to past research, volume effects were seen in the length and intensity of movement during the 1 ml and 10 ml swallows. The range of motion in older women was likewise greater than in older males. This rise could be a result of compensating for ageing effects that older men do not experience.

Another study by Humbert et al in 2009 examined age-related changes in swallowing from a imaging perspective. They investigated the relationship between swallowing-related brain activity as observed through functional MRI (fMRI) and the biomechanics of swallowing using videoflouroscopy. They examined three different bolus types – saliva, water, and barium – in a group of 12 young adults and 11 older adults. The findings highlighted distinct age-related changes in the neurophysiological aspects of swallowing suggesting that the older adult group exhibited a greater involvement of cortical regions and the heightened activation was particularly prominent in area like the pericentral gyri and the right- sided inferior frontal gyrus pars opercularis and pars triangularis. The older participants displayed longer delays before the onset of the pharyngeal swallow response and a greater accumulation of ingested material in the pharynx.

Aminpour et al. in 2011 compared the pharyngeal wall thickness in two different states – at rest and when maximally constricted during the act of swallowing – between two age groups: younger adults and older adults. The aim was likely to investigate potential age-related differences in the way the pharyngeal wall behaves and changes in thickness during the swallowing process. The study involved conducting videofluoroscopic swallow studies on a group of 178 normal adults. Measurements

were taken in two different states: at rest and during the moment of maximum constriction of the pharynx, which occurs during the swallowing of a 20-milliliter (ml) bolus in the swallowing process. The results revealed that the difference in pharyngeal wall thickness at rest between the two groups was statistically significant ($p < 0.01$), indicating that the posterior pharyngeal wall was thinner in the older group compared to the younger group. Additionally, the difference in pharyngeal wall thickness during maximum constriction between the two groups was statistically significant ($p < 0.01$). Based on these findings, it can be inferred that the posterior pharyngeal wall was not only thinner but also does not constrict to the same extent during swallowing in older individuals when compared to younger individuals, which suggests that there is some atrophy of muscles involved in the pharyngeal phase that are associated with ageing.

Wang et al. (2015) in his study utilized a non-invasive system to record age related changes in swallowing and respiration. This system incorporated piezoelectric sensors to track larynx movement, surface electromyography to monitor submental muscle activity, and nasal airflow measurement to analyse respiration-swallowing coordination. For the research, they enrolled a total of 112 healthy participants from the community. They were divided into three age groups:20-30 years, 31- 50 years and 51-70 years. The study uncovered distinct differences in oropharyngeal swallowing patterns among the different age groups. The participants in the old-age group exhibited delayed onset latency and longer swallowing apnea duration compared to the other age groups. These differences were more pronounced when larger boluses were used. The likelihood of piecemeal deglutition, where food is swallowed in multiple fragments, was found to be highest in the old-age group and lowest in the young-age group.

Mulheren et al. (2018) conducted a research where they utilized a well-established measurement tool for assessing swallowing impairment, called the MBSiMP (Modified Barium Swallow Impairment Profile, Martin-Harris et al. in 2008).

In their study, which included participants with an average age of 67.2 years, they found that certain parameters of swallowing were notably influenced by age. Specifically, the following parameters showed the most significant effects due to age: Anterior hyoid excursion, pharyngeal stripping, UES opening and tongue base retraction. This aligns with previous research conducted by Robbins et al. in 1992.

In another study by Molfenter, Lenell, et al. (2019), it was proposed that the volume of the pharynx tends to increase with age. This phenomenon is associated with a few factors, including atrophy of the pharyngeal muscles and a reduction in the extent of hyolaryngeal (hyoid bone and larynx) excursion during swallowing. These changes are believed to contribute to an elevated occurrence of residue in the vallecular and pyriform sinus areas following the act of swallowing (Walshe, 2019). Furthermore, there is evidence to suggest that the combination of an enlarged pharyngeal lumen and muscle atrophy may be responsible for the increased presence of residue in certain anatomical pockets after swallowing. This could lead to difficulties in clearing ingested material completely from the pharyngeal region (Walshe, 2019). These findings provide insights into the complex interplay between age-related changes in the pharyngeal anatomy, muscle function, and swallowing efficiency. Understanding these dynamics is essential for addressing potential swallowing difficulties that may arise in older individuals.

In a review conducted by Namasivayam-MacDonald et al. (2018), the timing aspects of swallowing in healthy older adults (aged over 60 years) were examined by reviewing multiple published studies. The researchers concluded that despite variations in the literature, there is a clear indication of differences in the timing of swallowing between older, healthy adults and younger cohorts (those under 60 years of age). Specifically, the study found that certain parameters related to the timing of the swallowing process are extended in elderly individuals compared to their younger

counterparts. These include: Swallow Reaction Parameters (the time between the entry of the bolus into the pharynx and the onset of hyoid excursion is longer in older individuals, Pharyngeal Delay Times (the amount of time the bolus spends in the pharynx before progressing further).

Furthermore, Feng et al. in 2023 also reported of a decrease in the tongue root retraction and incomplete opening of the UES, where, the resting pressure of the UES in older individuals was measured at 43 ± 5 mmHg, which was significantly lower than that of younger individuals (71 ± 8 mmHg; $P < 0.05$).

2.3.3 Ageing effects on the Esophageal phase of swallow

A study by Shim et al. (2017) aimed to assess and analyze the impact of age on esophageal motility in a total of 268 participants through high-resolution esophageal impedance manometry (HRIM). The participants were categorized into three distinct age groups: Group A (< 40 years) consisted of 32 individuals, Group B (40-65 years) included 185 participants and Group C (> 65 years) comprised 62 individuals. Several parameters related to esophageal function such as Lower esophageal sphincter (LES) and upper esophageal sphincter (UES) pressures, integrated relaxation pressure, distal contractile integral, contractile front velocity distal latency, pressures and duration of contractions at four different positions along the esophagus and complete bolus transit. were measured for each participant. The findings suggested a potential correlation between certain esophageal symptoms and age-related changes in esophageal motor function. Specifically, the observed decrease in UES pressure, as well as changes in distal esophageal motility and peristaltic velocity, could be associated with esophageal symptoms experienced by the aged population.

Mei et al. (2018) investigated the effects of ageing on the UES and esophageal body pressure responses. The study included two groups: 11 elderly healthy volunteers with an average age of 74 ± 9 years and 11 young healthy volunteers with an average

age of 28 ± 7 years. Concurrent HRIM and an esophageal infusion technique were employed to assess esophageal function. To mimic potential conditions of gastroesophageal reflux, two substances were infused: 0.1 N hydrochloric acid (HCl) and saline. The researchers evaluated UES and esophageal pressure responses during different infusion scenarios: Slow infusion (1 mL/s) for 60 seconds, followed by a 60-second post-infusion dwell period. Ultraslow infusion (0.05 mL/s) for 60 seconds, followed by a 60-second post-infusion dwell period. All infusions were repeated three times. Both young and elderly subjects experienced a significant increase in UES-CI during slow infusions as well as throughout the passive dwell intervals, as compared to baseline levels ($P < 0.01$ for both groups). Ultraslow infusions resulted in a significant increase in UES-CI only in the young group, specifically during the late infusion period and extending into the dwell interval ($P < 0.01$). During slow infusions and their associated dwell intervals, the young subjects displayed a higher occurrence of secondary peristalsis compared to the elderly subjects ($P < 0.05$). Active infusions were accompanied by a higher frequency of secondary peristalsis compared to the dwell intervals. In both the young and elderly groups, secondary peristalsis was relatively infrequent during ultraslow infusions. Overall, the findings suggested that the response of the UES, as indicated by the UES-CI, varied between different infusion rates and across age groups. The presence of secondary peristalsis, which is the contraction of the esophagus in response to esophageal distension, also demonstrated differences based on infusion scenarios and age.

Walshe (2019) explained that in healthy individuals who are very old (aged 80 to 90 years), it is possible for the presence of esophageal muscle weakness, despite the presence of a normal swallowing process. This phenomenon was observed in a study conducted by Robbins, Bridges, and Taylor in 2006. In other words, the muscles in the esophagus might not be as strong as expected, even though the act of swallowing itself

appears to be functioning normally. However, in older individuals, there is an elevated risk of encountering secondary esophageal peristalsis problems (the wave-like muscle contractions that move food along the esophagus) and gastroesophageal reflux disease (GERD), a condition where stomach contents flow back into the esophagus. These issues can predispose older individuals to an increased risk of aspiration associated with reflux. Aspiration occurs when foreign substances, such as stomach contents, enter the airway and lungs, which can be a serious health concern. The combination of esophageal muscle weakness, impaired peristalsis, GERD, and aspiration risk highlights the complexities and potential challenges in the esophageal function of older individuals. It underscores the importance of considering these factors when evaluating the swallowing and respiratory health of the elderly population.

2.4 Prevalence of Presbyphagia

Presbyphagia is seen in as high as 63% to 72% (González-Fernández et al., 2014; LaGorio et al., 2017). Arif et al. (2019) through their study found 39 out of 313 (12.4%) participants with asymptomatic swallowing disorders. According to Cavallaro et al. (2022), 33% over the age of 65 were identified with symptoms attributable to presbyphagia. In the Indian scenario, there are limited studies investigating the prevalence of presbyphagia. A study by Abdul Khader et al. (2018) suggested that 20.1 % of individuals aged ≥60 reported swallowing difficulty, with males being more likely to develop swallowing difficulties than females.

To record the prevalence and profile the swallow issues in the healthy elderly, several studies have been carried out using questionnaires that already existed to profile symptoms of swallowing difficulties in the clinical population. According to Tamura et al. (1997), the prevalence of choking with a test food (pudding) was found to be 7.5% among homebound elderly individuals in Tokyo. Similarly, Kamakura et al. (1998) reported that 12.7% of elderly individuals living at home in the suburbs of Nagoya

experienced choking while eating cooked rice, and 17.2% experienced choking while drinking green tea. However, it should be noted that both Tamura et al. and Kamakura et al. did not use established criteria for assessing dysphagia, and the sampling methods were not random. Therefore, these reports may not accurately reflect the true prevalence of dysphagia in these communities.

Another study done by Kawashima et al. in 2004 in Japan aimed at validating a dysphagia screening questionnaire and calculating the prevalence of dysphagia in the community-dwelling elderly population. They constructed a questionnaire to screen for dysphagia by adapting an existing screening questionnaire known as the dysphagia screening questionnaire that was originally developed by Ohkuma et al. in 2002 and was used to screen for dysphagia in patients who were hospitalized in nursing facilities specifically with neurovascular disease in Japan. Kawashima and team adapted the Ohkuma questionnaire into a 14-item dysphagia screening questionnaire which was sent to 2053 elderly individuals aged 65 and above in the Akita prefecture in Japan and 1313 participants gave back their response. Based on this data, the prevalence was calculated to be 13.8% and the presence of dysphagia increased with an increase in age. This study was more accurate than previous studies as the researchers conducted a thorough examination of the entire population in a specific community, leaving no individuals out, and ensured that there was no bias in the selection process.

In the West, Holland et al in the year 2011 administered the Sydney Swallow Questionnaire originally developed by Wallace et al in 2000, on 634 elderly individuals and the prevalence of dysphagia in this population was 11.4%. Approximately 13% to 35% of elderly individuals who reside independently have reported experiencing symptoms of dysphagia, with a significant majority of them not seeking medical intervention or treatment. In this study, a postal questionnaire was utilized to collect self-reported data on symptoms related to oropharyngeal dysphagia. The questionnaire

achieved a high rate of completion and employed visual analog scales to assess various symptoms.

2.5 Impact of age-related decline on swallow function

The age-related decline in swallowing function, also called Presbyphagia, can have a significant impact on the quality of life of older individuals. Swallowing is a complex process crucial for proper nutrition and hydration. When presbyphagia sets in, it can lead to various challenges that affect daily life:

Nutritional and Hydration Issues: Difficulty in swallowing may result in inadequate intake of essential nutrients and fluids. This can lead to malnutrition, dehydration, and subsequent health complications.

Social Isolation: Dining is often a social activity, and individuals with presbyphagia might avoid social gatherings or meals due to embarrassment or fear of choking. This isolation can lead to decreased social interactions and a reduced sense of well-being.

Decreased Enjoyment of Food: Swallowing difficulties can impact the pleasure derived from eating. The need for modified diets or restrictions on certain foods can lead to a diminished eating experience.

Risk of Aspiration and Pneumonia: In severe cases, presbyphagia can increase the risk of aspiration, where food or fluids enter the airway and lungs. This can lead to pneumonia, a serious medical condition.

Weight Loss and Muscle Weakness: Limited oral intake due to swallowing difficulties can lead to weight loss and muscle weakness, further affecting overall health and mobility**.**

Moreover, presbyphagia can go unnoticed, as individuals might consider changes in swallowing function as a normal part of ageing. Thus it is essential to screen for presbyphagia and identify it at the earliest. Screening helps identify these issues

early, allowing for prompt intervention. By detecting presbyphagia early, healthcare professionals can implement strategies to prevent malnutrition, dehydration, and respiratory complications associated with aspiration. The strategies might involve diet modifications, swallowing exercises, or referrals to specialists, which can significantly enhance the quality of life for older individuals. By managing swallowing difficulties, they can continue to enjoy meals, social interactions, and maintain proper nutrition and hydration. Early identification and management of presbyphagia can prevent hospitalizations due to complications like aspiration pneumonia, leading to reduced healthcare expenses. This will also lead to enhanced Care Planning. The knowledge of presbyphagia allows healthcare providers to include swallowing function in care plans, ensuring that patients' dietary and therapeutic needs are met.

2.6 Screening tools to identify swallowing difficulties in the elderly

To address age-related alterations and ensure early identification and intervention, various assessment tools originally designed for dysphagia evaluation are now being employed to screen for presbyphagia. These tools aid in identifying potential swallowing difficulties and promoting effective management strategies for the elderly population.

2.6.1 Utility of dysphagia screening tools to screen for presbyphagia

Initially, the questionnaire, known as the Sydney oropharyngeal dysphagia questionnaire, underwent validation in a group of patients with neuromyogenic dysphagia. It was compared to a global dysphagia score based on instrumental examinations and other clinical indicators. The questionnaire demonstrated a strong level of reliability when compared to this established standard. Subsequently, the questionnaire underwent further validation in patients with head and neck cancer. Although the tool lacks clinical examination data to support its findings, it appears to possess the necessary qualities to effectively screen a community for oropharyngeal

issues.

Another tool utilized for screening the elderly was the Gugging Swallow Screen (GUSS) developed by Trapl et al in 2007. Umay et al. in 2019 aimed at evaluating the effectiveness of GUSS as a screening tool used for identifying swallowing difficulties in the elderly. The GUSS test is an inexpensive, non-invasive assessment tool that involves three different types of food consistencies (solid, semisolid, and liquid) and various quantities of food that resemble those typically consumed in everyday life. The research involved a total of 1163 participants who were at least 65 years old. These individuals were receiving oral feeding and had been admitted to an outpatient physical medicine and rehabilitation (PMR) facility due to complaints related to musculoskeletal disorders, such as osteoporosis, degenerative osteoarthritis, low back pain, and neck pain. The data collection period for the study spanned from September 2017 to February 2019. Sensitivity and specificity were calculated to be 95.5% and 94.4% respectively, which indicated that GUSS was a valid and reliable tool for screening older individuals for oropharyngeal dysphagia who have no secondary dysphagia.

Garand et al. in the year 2020, investigated the ageing effects on Eating Assessment Tool- 10 (EAT-10) to understand how ageing and gender impacted the scores on the EAT-10. EAT-10 is a dysphagia screening self- administered questionnaire and was originally developed by Belafsky et al. in the year 2008. Garand et al included 195 healthy older individuals above the age 60. The study did not find any significant differences in EAT-10 total scores based on sex or age. Additionally, post-hoc analyses did not reveal a significant association between EAT-10 total scores and PAS (Penetration-Aspiration Scale) score. These findings suggest that the natural changes in the upper aerodigestive tract that occur during the ageing process do not necessarily lead to changes in the perceived difficulty of swallowing functions. Furthermore, the perceived impairment of swallowing function measured by the EAT-

10 questionnaire may not correlate with the actual occurrence of bolus airway invasion observed through videofluoroscopy.

The Swallowing Disturbance Questionnaire developed by Manor et al. in 2007 is a screening questionnaire that was developed to screen for swallowing difficulties among patients with Parkinson's disease. The questionnaire demonstrated high sensitivity and specificity in detecting symptoms of dysphagia, making it a reliable tool for identifying clinical abnormalities in swallowing within the patient population under study. It provided valuable information regarding the presence of swallowing difficulties in these individuals. This questionnaire was utilized by Abdul Khader et al. in the year 2018 to document the prevalence and etiology of swallowing difficulties in the healthy elderly population. A group of 259 individuals, consisting of 85 females and 174 males, were included in the screening process. The age of these individuals ranged from 61 to 98 years. The average age of the group was calculated to be 66.16 years, with a standard deviation of 6.233. In this study, the prevalence of swallowing difficulties among healthy elderly individuals was determined using the SDQ (Swallowing Difficulty Questionnaire) and was found to be 20.1%.

2.6.2 Screening tools and questionnaires developed specifically for presbyphagia

In the year 2002, Fukuda et al. conducted a study to develop a scale to assess the risk of dysphagia in community-dwelling elderly individuals. The objective of this study was to develop a dysphagia risk assessment scale specifically for elderly individuals residing at home. The scale initially consisted of 24 items and utilized a 4-grade answering method. It focused on assessing dysphagia related to ageing, diseases, aspiration, aspiration pneumonia, and malnutrition across four swallowing stages: oral preparatory stage, oral stage, pharyngeal stage, and esophageal stage. To refine the scale, structured interviews were conducted with 81 elderly individuals living in facilities, and a self-administered questionnaire survey involving 658 elderly

individuals living at home in Japan was carried out to assess its validity and reliability. In addition, a 3-ounce water swallow test was conducted as a gold standard. Through content validity analysis, 17 items were selected for the scale. Factor analysis was then performed to evaluate its validity, resulting in the identification of four factors: aspiration, poor pharyngeal clearance, difficulty in posterior propulsion of the bolus by the tongue and triggering the pharyngeal swallow, and esophageal dysphagia. Internal consistency analysis and test-retest reliability analysis were conducted to assess the reliability of the scale. The entire scale demonstrated a high level of internal consistency, with a Cronbach's alpha coefficient of 0.9, and the test-retest reliability yielded a correlation coefficient (r) of 0.62. Using the ROC curve, a cutoff value of 4 was determined, with a sensitivity of 57.1% and specificity of 69.6%. Overall, these findings validate and establish the reliability of the 17-item dysphagia risk assessment scale developed in this study.

Miura et al. in 2007 from Japan, aimed at evaluating the chewing and swallowing difficulties seen in community-dwelling elderly individuals. They did so by constructing a questionnaire which was titled “Dysphagia Risk Assessment for the community-Dwelling Elderly (DRACE)”. The survey was conducted in Miyazaki Prefecture, located in southern Japan, from December 2005 to February 2006. The average age of the elderly subjects in the study was 80.8 years with a standard deviation of 7.6 years. The principal medical histories of the subjects were as follows: 35.3% had hypertension, 21.2% had cardiopathy, 10.6% had diabetes, 9.4% had a history of cerebrovascular accident, 5.9% had arthritis, 5.9% had respiratory disease, and 4.7% had carcinoma. The survey items were categorized into the following groups: (i) Demographic variables: This includes information related to age, sex, and other relevant demographic factors.

(ii) Physical symptoms related to chewing and swallowing disorders: This

includes questions or items that assess any symptoms or difficulties experienced by the participants while chewing or swallowing food.

(iii) Clinical swallowing function test: This involves specific assessments or tests conducted to evaluate the participants' swallowing function.

(iv) Basic Activities of Daily Living (ADL): This includes items or questions aimed at assessing the participants' ability to perform basic daily activities independently, such as eating, dressing, bathing, and mobility.

(v) Screening test of cognitive function: This comprises assessments or questions designed to screen for cognitive function and detect any potential cognitive impairments or deficits in the participants.

These categories were used to organize the survey items and gather comprehensive information on various aspects relevant to the study. A 3-ounce water test, which is a commonly used clinical screening test for dysphagia, was administered to the participants. Those individuals who exhibited abnormal swallowing function during and after drinking water were identified as frail elderly with clinical dysphagia. This test was used as a criterion to determine the presence of dysphagia in the study population. The final DRACE questionnaire consists of an 18-item self-administered questionnaire. The scores obtained from the dysphagia risk assessment scale for community-dwelling elderly were found to have a significant relationship with the results of the 3-ounce water test ($p < 0.01$). This indicates that the dysphagia risk assessment scale is a valid tool for evaluating the risks associated with swallowing disorders in both frail and community-dwelling elderly individuals. The scale can effectively identify individuals at risk and assist in the assessment of swallowing difficulties in this population. However, the sample size was relatively small, which limits the generalizability of the findings to the entire community.

Madhavan et al. (2018) conducted a study to develop a screening tool for pre-

clinical dysphagia in older adults. This study focuses on the initial development of a new patient-reported outcome (PRO) screening tool for pre-clinical dysphagia. Initially, a set of 34 questions was developed based on a literature review and expert opinions. The questionnaire was then pilot tested with 53 participants and subsequently revised. It was further tested with an additional 335 community-dwelling older adults (CDOA) living in the United States of America. Various measures were conducted to assess face validity, content validity, item analysis, reliability (internal consistency), and construct validity (exploratory factor analysis). Through psychometric validation, a final 17-question PRO tool was derived. The construct analysis identified a three-factor model that accounted for 67.345% of the variance. These emergent factors represented swallowing effort, physical function, and cognitive function. The results demonstrated strong construct validity and internal consistency, with a Cronbach's alpha coefficient of 0.90. This novel PRO tool integrates multiple domains associated with ageing and exhibits promising preliminary psychometric properties. It provides a more comprehensive and ageing-focused approach compared to existing dysphagia screening tools. The inclusion of multiple domains may play a crucial role in early identification of pre-clinical dysphagia.

Sheikhany et al. in 2022 carried out a survey and aim of this study was to introduce a user-friendly tool that can be easily used by caregivers and general practitioners to screen for dysphagia in older adults. The purpose was to enable early detection of individuals who may be at risk for dysphagia. The goal was to provide a practical and accessible means of identifying potential swallowing difficulties in geriatric patients. The questionnaire was titled “Dysphagia Manifestations Questionnaire”. In this study, a sample of 200 elderly patients from nursing homes in the Greater Cairo area, who did not report any complaints of dysphagia, were recruited. These individuals, aged 65 years or older, along with their caregivers, completed a

screening tool specifically designed for this study. The screening tool included questionnaires related to dysphagia manifestations and eating habits. Furthermore, general, oral motor, and bedside evaluations were conducted. For validation purposes, suspected cases identified through the screening tool underwent additional assessments such as the completion of the EAT-10 questionnaire and FEES. The purpose of these assessments was to validate the effectiveness of the screening tool in identifying individuals with dysphagia. The dysphagia manifestations questionnaire exhibited a significant correlation with the EAT-10 questionnaire, with a p-value of 0.001. It also showed moderate reliability with some aspects of the FEES assessment, with p-values ranging between 0.012 and 0.044. For the dysphagia manifestations questionnaire, a cutoff point of a total score greater than 5 was determined. This cutoff had a sensitivity of 17.65% (the ability to correctly identify individuals with dysphagia) and a specificity of 94.20% (the ability to correctly identify individuals without dysphagia). Regarding the bedside evaluation, a cutoff point of a total score of ≤ 1 was identified. This cutoff had a sensitivity of 66.9% and a specificity of 56.9%. These findings provide information on the diagnostic accuracy of the screening tools used in this study, indicating their ability to identify individuals with dysphagia or those without dysphagia based on the established cutoff points.

2.7 Summary

Based on the literature, it is evident that ageing can lead to deterioration in the swallow function, which in turn can cause significant changes to one's lifestyle and dietary habits and can also lead to a compromised nutrition. Thus, there is a need to identify presbyphagia at the earliest. An in-depth look into the existing literature revealed that there are quite a few screening tools available in the western context, developed in countries such as Japan and Egypt, but there are none in the Indian context that are available specifically to screen for presbyphagia or pre-clinical dysphagia.

Moreover, the existing screening questionnaires do not take life activity and participation into consideration and therefore it is necessary to build a screening questionnaire that also looks into lifestyle, social and personal factors that are a consequence of presbyphagia. Pauranik et al. (2019) presented two contrasting perspectives regarding the development of tests. One group of researchers argues that there is no necessity to create new tests when there are established standardized screening tests already available. On the other hand, another group emphasizes the importance of considering linguistic and cultural variations and advocates for the development of indigenous tests tailored to specific populations. They concluded by accepting the viewpoint that diagnostic tools as well as screening tools must be made culturally appropriate to accommodate the cultural and contextual differences in different regions of the world. Hence, it can be concluded that a screening questionnaire specific to the Indian context can provide a great deal of value to the assessment protocol for identifying swallowing difficulties in healthy Indian elderly population.

CHAPTER III

METHOD

The aim of the current study was to develop a questionnaire for screening age related decline in swallow abilities in healthy older adults and validate the same on the Indian population. A cross-sectional study design and random sampling were used for the present study.

3.1 Participants

The participants for the study included community-dwelling healthy older adults from various retirement homes in India. The participants were sourced from various regions including Karnataka, Tamilnadu, Kerala and Goa. The study recruited 119 participants in the age range of 60 to 91 years (Mean- 73.94, SD- 7.91) with no complaints of dysphagia or no history of dysphagia. There were 60 males and 59 females. The participants were divided into three age groups: 60 to 69.11 years (44 participants), 70 to 79.11 years (40 participants) and above 80 years (80- 91 years) (35 participants). Table 3.1 contains demographic characteristics of the participants. The participants with common systemic diseases such as Hypertension (43 participants) and Diabetes (27 participants) who were under medication to control the disease were also included in the study. All the participants either belonged to the Lower Middle or Upper Middle class as given by the Modified Kuppuswamy Socio-economic Scale (Sood & Bindra, 2022).

Table 3.1 *Demographic characteristics of participants (N=119).*

Age	No. of Males	No. of Females
60- 69.11 years	16	28
70- 79.11 years	23	17
80- 91 years	21	14
Total	60	59

Individuals with co-morbidities, including neurological insults, physical trauma, cancer, dementia and other ailments were excluded. A questionnaire titled "World Health Organization Disability Assessment Schedule-Second Version (WHODAS 2.0)", a 12-item short version based on International Classification of Functioning Disability and Health (ICF) developed by WHO in 2010 was administered to rule out any co-morbidities and assess the cognitive abilities of the participants in question. This questionnaire provides a profile of functioning across six activity domains (i.e., cognition, mobility, self-care, getting along, life activities, and participation). The participants with any dysfunction in any of the six aforementioned domains were excluded. The screening questionnaire was administered to all individuals selected for the study.

When choosing study participants, ethical considerations were taken into account. Participants and their family members or caregivers were explained the objectives of the study and methods. The participants or caregivers involved in the study signed an informed consent form. The ethical committee guidelines for Bio-behavioral Sciences for human subjects (2009) developed at the All India Institute of Speech and Hearing, Mysore, were followed in the present study for collecting data.

3.2 Procedure

The study was conducted in three phases. They were:

3.2.1 Phase I: Design and development of the questionnaire

A detailed information for the questionnaire was collected by conducting structured interviews with older adults and their caregivers, which involved discussion on their eating habits, dietary changes and lifestyle, and problems faced while eating. A comprehensive review of the research and current literature on the ageing effects on swallowing was also carried out for a better understanding of the relevant questions to be included in the questionnaire (Kawashima et al., 2004; Miura et al., 2007; Sheikhany et al., 2022). The research articles for review were selected using a standard Google Scholar search and Scopus search. Common symptoms related to presbyphagia were reviewed (Burda, 2011) and were factored in, and changes in swallowing (Di Pede et al., 2016; Feng et al., 2023; Mccoy & Desai, 2018; Namasivayam-Macdonald & Riquelme, 2019; Ortega et al., 2014; Rech et al., 2022; Robbins et al., 1992; Shiozu et al., 2015; Tracy et al., 1989), including dietary intake (Cichero, 2018; Sumathi et al., 1999), nutritional status (Mathew et al., 2016; Shiozu et al., 2015), compensatory strategies (if any) and environmental factors, were taken into account. The screening questionnaires developed previously were reviewed and applicable questions were enumerated and built on.

The screening questionnaire was developed in English language, as it is a clinician administered tool. The preliminary draft of the questionnaire consisted of 20 questions targeting the most common signs and symptoms of presbyphagia. Examples of food items used in the Indian context were also included. A 3-point rating scale was also included: ‘Never’ with score 0, ‘Sometimes’ with score 0.5 and ‘always’ with a

score of 1. It was titled as “Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE)’**.**

Three SLPs with three years of experience in the field of swallowing disorders were asked to provide their expert opinion on the preliminary questionnaire by rating each question as "appropriate", "inappropriate", and " revision required" along with suggestions for revisions. The revisions suggested by the professionals included rephrasing the questions for ease of understanding, e.g., “Do you exert more effort or push hard to swallow the food?” rephrased to “Do you need to swallow hard for it to go?”. Other revisions suggested were to specify the symptoms of choking instead of using the word ‘choking’ and to make each question more relevant to the instance of swallowing, for example, that of weight loss and intake of smaller meals so the participants do not confuse them with an intentional weight loss or a general loss of appetite. The reviewers also suggested an addition of relevant questions pertaining to each phase of swallowing such as- “Do you find it difficult to move the food around inside your mouth?” and “Do you find it difficult to initiate a swallow once the food is chewed?”. The questions that were marked as "appropriate" were retained, and revisions and additions suggested by the SLPs in this phase were incorporated after which the total number of questions in the questionnaire increased to 23. The questions targeted the impact of ageing on different phases of swallowing, dietary and lifestyle changes.

3.2.2 Phase II: Validation of the SASQ-IE

Step 1: Content validation

The developed questionnaire was given to five SLPs/swallowing experts who had at least three years of experience in the field of swallowing disorders for

content validation. The steps for content validation were adapted from the procedure given by Yusoff in the year 2019. The questions in the tool were rated on a 4-point Likert scale, where 1 stands for 'extremely irrelevant', 2, 3 and 4 means 'irrelevant', 'relevant' and 'extremely relevant', respectively by each of them. All 23 questions were either rated as 'relevant' or 'extremely relevant' by all the experts along with suggestions on how to modify the questions marked as 'relevant'. The suggestions given included- separating the question- "Does water or food spill out of your mouth while eating or drinking?" into two questions; one specifying liquid consistency (water) and another specifying solid consistencies (food), to specify the food consistencies such as liquid, solid and semi-solid for relevant questions and to add questions related to their social participation. A question to differentiate between symptoms of gastroesophageal reflux disorder and swallowing disorder was also suggested.

The questions that were rated as 'extremely relevant' and 'relevant' by more than three SLPs were retained in the questionnaire. The suggestions were incorporated and additions were made as recommended. The questions were re-arranged in the order of impact of ageing on oral phase, pharyngeal phase and esophageal phase of swallow and the consequent limitations in activity and participation restrictions. The final questionnaire contained 25 questions which were to be rated as 'never' with a score of 0, 'sometimes' with a score of 0.5 and 'always' with a score of 1. The final version of the validated questionnaire titled as 'Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE)' has been included in Appendix A.

Step 2: Pilot study

Five participants (healthy elderly, who met the inclusion criteria) were considered for the pilot study. The tool developed after content validation was

administered to the said participants and was subjected to scrutiny to determine its transparency, relevancy and understandability. The ease of administration, comprehensibility of each and every question in the questionnaire and rationality of the same was looked into and no further changes were made to the questionnaire. It was seen that the time taken to administer the questionnaire was a total of 15 minutes.

Step 3: Administration of SASQ-IE

SASQ-IE was administered on a total of 119 older adults in the age range of 60 to 91years, who were selected using systematic random sampling. The data was collected face-to-face after explaining the need for the study and getting their consent in a quiet room with no distractions. The participants were asked to be seated in a comfortable position while administering the tests. The demographic data of the participants were collected. The participants were instructed to listen carefully to each question in the screening questionnaire and encouraged to ask for repetitions whenever necessary before giving an answer. The answers were then documented by the clinician using the rating scale.

Step 4: Construct validity

The construct validation of the tool was carried out by administering the Gugging Swallow Screen (GUSS, Trapl et al., 2007) along with the developed questionnaire and correlating the scores of GUSS with the SASQ-IE. The GUSS has demonstrated valid and reliable measurements for the evaluation of dysphagia in healthy older adults (Umay et al., 2019). The GUSS offers a brisk screening and safe dependable method to recognize dysphagia and risk of aspiration with various consistencies primarily in individuals with stroke. GUSS includes Indirect swallowing test (total score:5), which involves a simple saliva swallowing test along with the

assessment of vigilance, voluntary cough, and throat clearing. It also includes a Direct swallowing test (total score:15) and is performed sequentially for semisolids, liquid and solids swallowing trials. A combined total score of 20 is obtained for both sections of GUSS and is interpreted as no dysphagia. The severity of dysphagia can be estimated using GUSS. Though it is standardized on stroke population, it has been used to assess dysphagia consequent to other etiologies (Frank et al., 2021; Umay et al., 2019). During the administration of GUSS, the participants were shown the food items that were to be consumed and were asked if they were comfortable eating them. The test items included biscuits for solid consistency, mashed banana for semi-solid consistency and water for liquid consistency.

3.2.3 Phase III: Reliability measurement

The reliability of the questionnaire was measured by doing a test-retest reliability measure, where the screening questionnaire was re-administered to 10% of the total participant population, which included 20 participants. There was an interval of two weeks between the first administration and second-time administration of the test. It provided information regarding the differences between the test and retest scores, which was then subjected to statistical analysis.

The inter-rater reliability measure was carried out by having another SLP to administer the test on 10% of the total participants (20 participants). The scores of the two testers were also subjected to statistical analysis.

3.3 Statistical analysis

The scores of the developed questionnaire and GUSS were computed for each participant. The obtained values were tabulated and subjected to descriptive statistics using Statistical Package for Social Sciences (SPSS v26.0 for Windows; SPSS Inc.,

Chicago, IL). A test of normality using Shapiro-Wilk's test was done across age groups and gender and as the variables were not normally distributed, a non-parametric test was carried out. The Kruskal- Wallis test and Mann-Whitney U test was carried out to find the significant difference across the age groups and gender. To determine the construct validity between the GUSS and the developed questionnaire and test-retest reliability, Spearman's Rank Order correlation was carried out. To determine the inter-rater reliability, Kappa Co-efficient was calculated. The internal consistency of the questionnaire was carried out by measuring the inter- item correlation using Cronbach's Alpha.

CHAPTER IV

RESULTS

The objective of the present study was to develop and validate a questionnaire to screen for the presence of presbyphagia or ageing swallow in otherwise healthy older adults. This study also examined differences in swallowing functions across gender and age groups. A screening questionnaire was developed after a thorough review of the literature and examining other screening tools developed in the West along with a three-point scale as 'Always', 'Sometimes' or 'Never'. To validate the content of the screening questionnaire, it was sent to five Speech- Language Pathologists, who rated each question on a 4- point Likert scale, that is, Score- 1 indicating Extremely irrelevant, Score-2 indicating irrelevant, Score- 3 indicating Relevant and Score-4 indicating Extremely relevant. Based on the opinions and suggestions made by the validators, changes were made accordingly. The final validated questionnaire titled as 'Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE)', consisted of 25 questions spread across three domains: Limitations in Activity (5 questions- Q No.1 to 5), difficulties in the Oral, Pharyngeal and Esophageal phase (17 questions- Q No. 6-22) and Participation restrictions (3 questions- Q No. 23-25).

SASQ-IE was administered on one hundred and nineteen older adults in the age range of 60 to 91 years. To assess the construct validity, the Gugging Swallow Screen (GUSS) developed by Trapl et al. (2004) was also administered and the scores of GUSS was used to compare it with the scores of SASQ-IE. The scores obtained from the SASQ-IE on healthy older adults were tabulated and subjected to statistical analysis using SPSS Version 26. The scores of SASQ-IE were compared across age groups (60 to 69.11 years,

70 to 79.11 years and 80 to 91 years) and gender. Since Shapiro Wilk's test for normality revealed that the data did not follow a normal distribution ($p<0.05$), non-parametric measures were used. To determine the construct validity, test-retest and inter-rater reliability, Spearman's Rank Order correlation was carried out. The results have been presented under different sections below.

4.1 Performance on SASQ-IE

The descriptive statistics were carried out for the total score of SASQ-IE and for the different domains of SASQ-IE. It was seen that the mean score of the participants in the study on the SASQ-IE was 5.22 (SD= 2.64), which indicated that swallowing problems were present in the participants, as against the mean score that possibly could be obtained for those without swallowing difficulties (Mean=0.00). The oral, pharyngeal, and esophageal difficulties had an impact on the activities and participation as reflected through the mean scores, as the mean on these two sections was high. The mean score obtained in the domain on activities was 0.15 (SD= 0.31) and the mean score obtained on the domain of participation was 0.05 (SD= 0.18). On comparison of the mean values of the difficulties faced across the oral and pharyngeal phase, it was seen that the mean score of difficulties faced in the pharyngeal phase was higher by 0.26 than the oral phase. The mean for difficulties faced in the oral phase was 1.02 (SD= 1.18), and difficulties in the pharyngeal phase was 1.28 (SD=1.46). The mean score for the esophageal phase were notably lower, around 0.092, indicating that lesser percentage of individuals reported difficulty in this phase.

The percentage of responses obtained on each question of the SASQ-IE for the 119 healthy older adults is given in Table 4.1. When the percentage of responses obtained as 'always' were compared across questions in the second domain (difficulties in oral,

pharyngeal and esophageal phase), it was found that the highest number of participants (17.6%) always had a difficulty in the question 10 (Do you have trouble chewing solid food like chakli, peanut barfi etc?). The second highest percentage of individuals (7.6%) who had responded as ‘Always’ for the second domain was for the question 11 (Do you chew the food more slowly and carefully, taking longer time to complete the meal?).

For the same domain, the percentage of individuals who had marked ‘sometimes’ were highest (37.8%) for question 17 (Do you cough/ Choke/ Clear your throat more often while you’re talking to other people when eating?). The second highest percentage of individuals (32.8%) who had marked ‘sometimes’ was for question 18 (Do you feel like the food you ate is stuck in your throat?).

Regarding limitations in the Activity domain, the question with the highest percentage (18.5%) of respondents reporting constant difficulty was Question 5 (Have you stopped eating spicy food?). Following closely was Question 2 (Have you made any changes in your diet due to a swallowing difficulty?) with 10.1% of participants indicating 'always' as their response. With regard to the Participation Restriction domain, highest percentage (2.5%) of individuals consistently experiencing challenges was observed in relation to Question 24 (Do you feel embarrassed/ uncomfortable to eat in social gatherings?).

It was found that the percentage of responses for each question for the option of ‘sometimes’ was equal or greater than the percentage of responses on the option of always. This indicated that participants did experience all the problems listed in the questionnaire occasionally than all the time consistently.

Table 4.1 *Percentage of rating on SASQ-IE questions. Q1 to Q5- Limitations in Activity, Q6 to Q22- Difficulties in Oral, Pharyngeal and Esophageal Phase, Q23 to Q25- Participation restrictions*

SASQ-IE Questions	Never	Sometimes	Always
Q1	75.6%	22.7%	1.7%
Q2	79.8%	10.1%	10.1%
Q3	81.5%	9.2%	9.2%
Q4	92.4%	5.9%	1.7%
Q5	58.0%	23.5%	18.5%
Q6	73.1%	26.1%	0.8%
Q7	74.8%	25.2%	0.00%
Q8	89.9%	8.4%	1.7%
Q9	80.7%	15.1%	4.2%
Q10	52.9%	29.4%	17.6%
Q11	68.9%	22.7%	7.6%
Q12	88.2%	10.1%	1.7%
Q13	84.9%	14.3%	0.8%
Q14	68.1%	26.9%	5%
Q15	82.4%	16.8%	0.8%
Q16	75.6%	22.7%	1.7%
Q17	58%	37.8%	4.2%
Q18	62.2%	32.8%	5%
Q19	84.9%	12.6%	2.5%
Q20	71.4%	26.1%	2.5%
Q21	80.7%	17.6%	1.7%
Q22	83.2%	15.1%	1.7%
Q23	92.4%	5.9%	1.7%
Q24	89.9%	7.6%	2.5%
Q25	91.6%	6.7%	1.7%

4.2 Comparison of SASQ-IE scores across gender

The scores obtained on the SASQ-IE were compared across gender. There were totally 60 male participants and 59 female participants (M=73.94, SD- 7.91) of which 16 males (M=64.5, SD= 2.93) and 28 females (M=66.03, SD= 1.93) were of age 60-69.11 years, 23 males (M=74.17, SD=2.64) and 17 females (M=74.76, SD=2.044) belonged to age group 70-79.11 years and 21 males (M=84.28, SD=2.16) and 14 females (M=83.64, SD=3.06) belonged to the age group 80-91 years.

Table 4.2 *Mean and Standard Deviation of SASQ-IE scores across gender*

Age Group	Mean		Standard Deviation	
	Males	Females	Males	Females
60-91 years	3.51	2.85	3.23	0.40
60-69.11 years	1.31	0.803	1.97	0.74
70-79.11 years	2.54	3.23	2.28	2.04
80-91 years	6.23	6.28	3.00	3.70

The mean and standard deviation of SASQ-IE scores across different age groups have been depicted in Table 4.2. On comparison of the overall mean of 60-91 years, it was seen that the males had a higher mean score compared to females. However, when the mean of each age group was compared, it was seen that only the mean score of the males in the 60 to 69.11 years was higher. In the other two age groups, the females had a higher mean score. The results of the Mann- Whitney U test revealed that there was no significant difference in the total SASQ-IE scores across gender *(/z/* = 1.10, p = 0.27).

4.3 Comparison of SASQ-IE scores across age groups

The scores obtained on the SASQ-IE were compared across age groups. There were 44 participants in the age range of 60-69.11 years (Mean= 65.47, SD= 2.46), 40

participants in the age range of 70-79.11 years (Mean= 74.42, SD= 2.42) and 35 participants in the age range of 80- 91 years (Mean= 84.02, SD= 2.57). The descriptive statistics revealed that the mean of the total SASQ-IE score increased with age. Table 4.3 depicts the mean and standard deviation of the overall SASQ-IE scores for all the age groups. This indicated that swallowing functions declined as age increased.

Table 4.3 *Mean and Standard Deviation of participants of total SASQ-IE scores across age groups.*

Age Group	Mean	Standard Deviation
60-69.11 years	0.98	1.37
70- 79.11 years	2.83	2.24
80- 91 years	6.44	3.21

The Kruskal-Wallis test was carried out to compare the mean scores across age groups. The results revealed that there was a high significant difference (x^2=58.40, p= 0.00) across the groups for the total SASQ-IE scores. Hence, a post-hoc analysis was carried out and the pairwise comparison was made between the three age groups on the total SASQ-IE scores. The Mann-Whitney U test was utilized for the same and the /z/ and p- values are depicted in Table 4.4. A high significant difference was found between all the age groups on the total scores of SASQ-IE.

Table 4.4 *Results of Mann- Whitney U test of comparison of total SASQ-IE scores across different age groups.*

Group	/z/	P value*
60-69.11 – 70-79.11 years (Pair 1)	3.61	0.00
60-69.11 – 80-91 years (Pair 2)	7.64	0.00
70-79.11 – 80-91 years (Pair 3)	4.10	0.00

*p<0.01

4.4 Comparison between SASQ-IE and GUSS scores

The construct validity of SASQ-IE was analyzed by correlating the total score of the Gugging Swallow Screen (GUSS, Trapl et al., 2007) with the total scores of SASQ-IE using Spearman's Rank Order Correlation. Higher scores on GUSS indicate better swallowing abilities, while higher scores on SASQ-IE indicate poorer swallowing abilities. The results revealed a statistically significant strong negative correlation between the GUSS scores and the SASQ-IE scores (correlation coefficient ρ = -0.80, p-value = 0.00). The construct validation of the SASQ-IE with GUSS confirms its validity as a valuable tool for screening for swallow functions in elderly individuals.

4.5 Reliability

Test-retest reliability and inter-rater reliability was carried out for 20 participants (16.81% of the total participants) and were subjected to statistical analysis. The test-retest reliability was determined by correlating the scores obtained in the first test and the scores obtained in the second test, between which there was a gap of two weeks. Spearman's Rank Order correlational analysis was done and the correlation co-efficient (*r*) was 1.00 and p value was 0.00. This indicated a high correlation which was statistically significant.

The inter-rater reliability between the two raters was determined by the measure of agreement using Kappa coefficient. The results revealed that the Kappa co-efficient (*K*) was

1.00 which indicated 100% agreement between rater 1 and rater 2 and the p value was found to be 0.00, which was statistically significant.

The internal consistency of the questionnaire was measured with Cronbach's Alpha (α) which was found to be 0.91, indicating that the internal consistency of the questionnaire was excellent ($\alpha \geq 0.9$).

4.6 Summary

To summarize the findings, a questionnaire titled SASQ-IE with three major domains (Limitations in activity, Difficulties in oral, pharyngeal and esophageal phase and Participation restrictions) was developed to assess ageing swallow in elderly Indian individuals. The psychometric properties of this tool was also determined which revealed that the questionnaire had a high reliability and validity. The total mean scores of SASQ-IE revealed that the elderly had reduced swallowing abilities which impacted their activity and participation. Statistical comparisons were also made between age groups and gender using non-parametric test measures such as the Kruskal Wallis test and Mann Whitney U test. The results revealed that there was a significant difference in the total SASQ-IE scores between age groups, however there was no significant difference across gender. The results of the study are discussed in greater detail in the upcoming chapter.

CHAPTER V

DISCUSSION

This study aimed at developing and validating the 'Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE)' for identifying swallowing changes and difficulties in older individuals who do not generally complain of dysphagia. The questionnaire was validated for its contents and the final version consisted of 25 questions that involved three domains: Limitations in activity, Difficulties in oral, pharyngeal and esophageal phase of swallowing and Participation restrictions. The questionnaire was also assessed for its clinical validity, test-retest and inter-rater reliability. The results revealed several interesting findings pertaining to swallow functions in elderly Indian population. The findings are discussed under the following sections:

i) Performance of healthy older adults on SASQ-IE

ii) Performance of healthy older adults on SASQ-IE across gender

iii) Performance of healthy older adults on SASQ-IE across age groups

iv) Construct validity of SASQ-IE

v) Reliability of SASQ-IE

5.1 Performance of healthy older adults on SASQ-IE

The mean scores for different phases; oral, pharyngeal, and esophageal—and for activity and participation domains were calculated to assess the performance of the elderly participants as a part assessing clinical validity. The highest scores were observed in the pharyngeal phase (Mean = 1.28, SD = 1.46), followed by the oral phase (Mean = 1.02, SD = 1.18). The mean score for the esophageal phase were notably lower, around 0.092, suggesting lower number of individuals who reported difficulty in this phase. It was evident that both the pharyngeal and oral phases of swallowing were affected among the

participants. Every participant reported experiencing difficulties, sometimes or always, in response to at least one question related to these swallowing phases. These findings align with the research of Sheikhany et al. (2022) and are consistent with studies conducted by Kawashima et al. (2004) and Wang et al. (2005). The prevalence of oropharyngeal dysphagia among the elderly is notably high and is recognized as a geriatric syndrome according to Sheikhany et al. (2022) and Rofes et al. (2010).

A commonly reported issue, with 17.6% of participants indicating 'Always,' pertained to experiencing difficulty chewing solid or hard foods. The results of the present study are in line with previous research, such as the study conducted by Lim et al. in 2018, which observed similar dietary modifications among older individuals, particularly those with poor dentition or dysphagia. These individuals often reduce their consumption of vegetables and meat while favoring high-carbohydrate foods that are easier to chew and swallow. A study by Millwood and Heath (2000) also highlights a comparable discovery. In their study, half of the participants were hesitant to consume foods they found difficult to eat. This implies that they might be avoiding these foods in their diet. Some individuals employed strategies like cooking food longer or cutting it into smaller pieces to manage the challenging foods, indicating their efforts to adapt to their swallowing difficulties. This correspondence between our findings and earlier studies underscores the consistent difficulties faced by older individuals in chewing solid food.

Another significant observation was that 37.8% of the participants reported occasional instances of aspiration or choking during conversations with others. Previous research has frequently highlighted that aspiration and choking incidents related to food are prevalent as individuals age, often due to compromised swallowing safety. Such incidents are frequently linked to delayed laryngeal vestibule (LV) closure, as outlined by

Rofes et al. in 2010. Smith et al. (1999) noted that the instances of aspiration increases as age increases. Another discovery in the current study was that 32.8% of the participants experienced sensations of food becoming lodged in their throats from time to time. This finding closely parallels the results of the study by Sheikhany et al. (2022), where out of 300 participants, 26.5% reported encountering the sensation of food sticking in their throat. Collectively, these findings underscore the prevalence of swallowing-related difficulties and sensations among individuals as they age. The observed instances of aspiration, choking, and the sensation of food sticking in the throat reflect the multifaceted challenges that can affect older individuals' swallowing function and safety.

The performance on the activity domain revealed a notable trend: a significant number of participants altered their dietary habits. These adjustments included reducing or entirely eliminating the consumption of spicy foods and making changes in their diet, for example, eating mashed food instead of hard solids. The primary reason for these changes was the difficulty participants experienced in chewing and swallowing. These modifications often occurred as individuals aged and were consistent with the findings of Millwood and Heath, (2000) and Cichero (2018). Their study noted that older individuals tended to modify their dietary choices to enhance safe swallowing, driven by an increased risk of swallowing difficulties compared to younger adults. Additionally, they commonly opt for 'soft' foods due to factors such as tooth loss and chewing fatigue.

In the Participation domain, with 2.5% of individuals consistently expressing challenges related to feeling embarrassed or uncomfortable while eating in social gatherings, it suggests that a smaller but notable group of participants experience emotional and social limitations due to their swallowing difficulties. This may indicate that swallowing issues can impact their social interactions and confidence in such settings.

These findings indicate that certain aspects of swallowing difficulties have a notable impact on participants' daily lives and social interactions.

The SASQ-IE stands out as a unique questionnaire due to its comprehensive approach in assessing the impact of swallowing difficulties on an individual's life. Unlike other questionnaires, the SASQ-IE goes beyond solely evaluating physical symptoms and delves into the broader realm of participation within the community and limitations in daily activities. By considering both the social aspects and practical challenges individuals face, this questionnaire provides a more holistic understanding of the far-reaching effects of swallowing difficulties on their quality of life.

5.2 Performance of healthy older adults on SASQ-IE across gender

The SASQ-IE scores were compared across gender and the results of the Mann-Whitney U test indicated that there was no statistically significant difference between males and females in terms of their scores on the questionnaire. The p value of 0.27 suggests that the observed difference in scores could likely have occurred due to random chance rather than being a meaningful or significant difference. In other words, based on the data collected, there is insufficient evidence to conclude that gender has a notable influence on the total SASQ-IE scores. This suggests that the nature of swallowing difficulties did not differ across males and females.

The same was observed in another study by Kawashima et al. (2004) who utilized the dysphagia risk assessment scale on 1313 elderly people and still found no significant difference between the two genders. That being said, a study by Smith et al. (1999) evaluating the incident and characteristics that are associated with silent aspiration and the study's univariate analysis suggested that in the group where silent aspiration occurred once during a swallow, age, gender, and medical diagnosis were associated with this

phenomenon. The author pointed out that in the studied population, men were more likely than women to experience silent aspiration during swallowing. One potential explanation for this observed difference is that men might be more prone to certain medical conditions that are closely associated with silent aspiration. Another possibility could be that the men in the study were dealing with more severe health issues compared to the women. Additionally, it is hypothesized that smoking might contribute to this gender-based difference. Smoking could potentially reduce the sensitivity of the laryngeal area to aspiration, leading to a lack of coughing response even when aspiration occurs. However, it is important to note that the present study did not directly examine the relationship between smoking and silent aspiration and did not involve those who are at risk of having dysphagia or individuals with presbyphagia. Hence, further research is needed to investigate this potential link. Overall, these findings highlight the complexity of factors that can contribute to dysphagia.

5.3 Performance of healthy older adults on SASQ-IE across age groups

The participants were categorized into three age groups: 60 to 69.11, 70 to 79.11 years, and 80 to 91 years. Initially, a comparison of the total scores obtained from the SASQ-IE was made across these age groups, revealing a statistically significant. Subsequent pairwise comparisons brought to light significant variations in SASQ-IE scores between the distinct age groups.

The observed trend indicated that the oldest cohort (80-91 years) with the highest mean score, had more pronounced swallowing difficulties compared to the other age groups, namely 60-69.11 years and 70-79.11 years. This trend suggested a linear increase in swallowing difficulties with advancing age. These findings align with several prior studies, including those conducted by Holland et al. (2011), Sheikhany et al. (2022), and

Byeon (2016).

These results could imply a progressive decline in the physiological and functional aspects of the oral phase of swallowing as individuals advance in age. Factors such as decreased muscle strength, changes in reflexes, and alterations in sensory perception that often accompany ageing might contribute to these observed difficulties (Calhoun et al., 1992, Walshe, 2019). Consequently, this underscores the importance of tailored interventions and support for elderly individuals, especially those within the older age ranges, to maintain and enhance their swallowing abilities, promoting overall health and well-being.

5.4 Construct validity of SASQ-IE

In assessing the construct validity of the current test, the researchers conducted a comparison with the Gugging Swallow Screen (GUSS) as administered by Trapl et al. (2007). This comparison aimed to establish a meaningful connection between the scores obtained from the SASQ-IE and those from the GUSS. Notably, higher scores in GUSS indicated better swallowing performance, whereas in the SASQ-IE, lower scores indicated better performance. Consequently, a negative correlation coefficient between the two tests was desirable to indicate a strong relationship.

The Spearman's rank correlation analysis revealed that participants' performance on both the SASQ-IE and the GUSS exhibited similarities. This was supported by a robust negative correlation observed between the results of the two tests. This negative correlation aligns with the goal of construct validity, further establishing a strong association between the two screening tools.

These findings resonate with earlier research endeavors aimed at developing screening questionnaires. Similar outcomes were reported in studies conducted by

Madhavan et al. (2018), Miura et al. (2007), and Sheikhany et al. (2022). These collective results affirm the construct validity of the SASQ-IE as a suitable tool for identifying swallowing difficulties among the elderly, effectively aligning its outcomes with established assessment methods.

5.5 Reliability measurements of SASQ-IE

The reliability assessments provided valuable insights into the consistency and dependability of the results obtained from the SASQ-IE questionnaire. The test-retest reliability analysis, which involved comparing participants' scores from the first test with scores from a subsequent test conducted two weeks later, showed a high correlation coefficient (r) of 1.000. This indicates that the participants' scores remained remarkably stable across the two testing sessions. The associated p value of 0.00 signifies that this strong correlation was statistically significant, further bolstering the confidence in the questionnaire's consistency over time.

The inter-rater reliability assessment, focusing on the agreement between two independent raters, revealed a Kappa coefficient (K) of 1. This perfect Kappa coefficient indicates that Rater 1 and Rater 2 exhibited 100% agreement in their evaluations. The p value of 0.000 emphasizes that this high level of agreement was statistically significant, reinforcing the notion that the SASQ-IE yields consistent results irrespective of the examiner administering the questionnaire.

Cronbach's Alpha (α) is a statistic commonly used to measure the internal consistency reliability of a questionnaire or scale. It assesses the extent to which all the items in a questionnaire or scale are measuring the same underlying construct or concept. In this study, the Cronbach's Alpha was calculated to be 0.91 which indicates that there was a high degree of correlation among the items in the questionnaire. In other words, the

responses to the items on the questionnaire tend to move together in a consistent manner, indicating that they are measuring a similar or related concept. A Cronbach's Alpha value of 0.91 is considered to be excellent in terms of internal consistency. Generally, higher values of Cronbach's Alpha (closer to 1) indicate stronger internal consistency, which means that the items in the questionnaire are highly correlated with each other and are collectively reliable in measuring the intended construct (Tavakol et al., 2011). In the study by Miura et al. (2007), Cronbach's Alpha was found to be 0.88 and the study by Sheikhany et al. (2022), Cronbach's Alpha was found to be quite reliable and this shows that the internal consistency of the SASQ-IE was higher by 0.03 than the Dysphagia Risk Assessment for the Community-Dwelling Elderly (DRACE).

In essence, these reliability assessments collectively indicate that the SASQ-IE questionnaire is a highly consistent and dependable tool for evaluating swallowing difficulties in the elderly. Both the strong test-retest correlation and the perfect inter-rater agreement underscore the robustness of the questionnaire's results, making it a reliable instrument for clinical and research purposes.

To summarize, the preceding sections detailed the observed disparities in each subsection of the test, accompanied by relevant literature support. The study's noteworthy outcomes align with existing research, substantiating their significance. Therefore, based on the investigation, it is reasonable to assert that the SASQ-IE holds promise as a precise and valid screening tool for identifying elderly Indians with presbyphagia.

CHAPTER VI

SUMMARY AND CONCLUSIONS

As the global ageing population continues to grow, effective evaluation for swallowing difficulties becomes imperative in the field of geriatric care. Early detection and intervention for presbyphagia, characterized by swallowing difficulties in older individuals, are vital for improving their quality of life. By utilizing screening questionnaires, tailored interventions can be designed to address specific symptoms. Moreover, the absence of tools tailored to the Indian context highlights the necessity for region-specific assessment instruments. Variations in anatomical structures, dietary habits, culinary practices, utensils used, meal patterns, and other factors among individuals worldwide can impact swallowing function. This underscores the need for tools designed for specific ethnic groups. The primary aim and objective of this study was to create a questionnaire capable of evaluating subtle swallowing challenges present in older individuals who typically do not express complaints of dysphagia and to subsequently validate the same. A review of existing literature indicated that screening instruments are commonly utilized as the primary assessment methods due to their characteristics of being quick, user-friendly, and demonstrating strong internal consistency and reliability.

The Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE) was formulated through a meticulous amalgamation informed by the extensive literature review and expert opinion. The questionnaire was developed and validated with input from five experienced Speech-Language Pathologists (SLPs). All the questions were rated as 'relevant' or 'extremely relevant,' with experts providing suggestions for improvements. Questions rated as such by more than three SLPs were retained. Suggestions included

separating questions for food and liquid spillage, specifying food consistencies, adding social participation-related questions, and differentiating between reflux and swallowing symptoms. The final questionnaire comprised of 25 questions, each assigned a rating: 'never' with a score of 0, 'sometimes' with a score of 0.5, and 'always' with a score of 1.' The questions were divided into three domains; Limitations in Activity, Difficulties in Oral, Pharyngeal and Esophageal Phase and Participation restrictions.

The SASQ-IE, designed to assess swallowing abilities in older Indian adults, was administered to a sample of 119 individuals aged between 60 and 91 years. The participants were categorized into three age groups: 60-69.11 years (44 participants), 70-79.11 years (40 participants), and 80-91 years (35 participants). The participants were chosen through systematic random sampling.

The raw scores were organized and subjected to statistical analysis utilizing the IBM SPSS software package (version 26.0). Descriptive statistics, including mean (M), median (Md), and standard deviation (SD), were computed for each domain within the participant groups. Non-parametric tests, such as the Kruskal- Wallis test the Mann-Whitney U test, were employed to discern noteworthy distinctions between individuals of different age groups and gender. To ascertain the construct validity of the SASQ-IE, GUSS was administered and the scores of GUSS was compared with the scores of SASQ-IE. Spearman's Rank Order correlation was utilized to establish test-retest reliability, while interrater reliability was determined by calculating the agreement measure between raters using the Kappa coefficient (K).

The study compared SASQ-IE scores between genders, finding no significant difference ($p = 0.272$) in scores. Participants were also divided into three age groups: 60-69 years, 70-79 years, and 80-91 years and the performance on SASQ-IE was compared

across these groups. Pairwise comparisons using the Mann- Whitney U test affirmed that there was a significant difference across age groups with the oldest group having the highest mean score, highlighting increasing challenges with age. This highlights a distinct link between age progression and heightened swallowing problems.

The comparison of oral and pharyngeal swallowing phases indicates that, on average, the pharyngeal phase presents greater challenges and is more affected than the oral phase across various age groups. Moreover, as individuals age, the difficulties during the pharyngeal phase tend to increase. This insight holds significance for healthcare professionals and researchers in their efforts to comprehend and manage swallowing issues in diverse populations.

To assess the construct validity of SASQ-IE, a comparison with GUSS was conducted. The Spearman's rank correlation analysis revealed that participants' performance on both the SASQ-IE and the GUSS exhibited similarities. This was supported by a robust negative correlation observed between the results of the two tests. This negative correlation aligns with the goal of construct validity, further establishing a strong association between the two screening tools.

The test-retest analysis revealed strong stability in scores over time, with a high correlation ($r = 1.00$) and a significant p-value (0.00). Additionally, the inter-rater reliability demonstrated perfect agreement ($K = 1$) between Rater 1 and Rater 2, supported by a significant p-value (0.00). These results underscore the reliability of the SASQ-IE, as it produces consistent outcomes regardless of the administering rater. The calculated Cronbach's Alpha of 0.91 demonstrates a high level of correlation among the questionnaire items. This suggests that the responses to the questionnaire items consistently align with each other, indicating that they measure a closely related concept.

An Alpha value of 0.91 is considered excellent for assessing internal consistency.

This study marks an initiative in the Indian context by introducing the SASQ-IE, a tool developed to assess the intricacies of ageing swallow function. Distinguishing itself from existing tools, this instrument takes into account the specific needs and nuances of the Indian population, acknowledging that dietary habits may differ from Western counterparts. What makes the SASQ-IE especially noteworthy is its comprehensive approach, encompassing not only the physiological aspects of swallowing but also its impact on daily life activities and participation. By considering how swallowing disorders influence individuals' engagement in life activities, this tool becomes a valuable resource, not only bridging a crucial gap in healthcare but also enhancing the quality of life for ageing Indians.

Implications of the study

- This culturally pertinent questionnaire-based screening tool holds the potential to effectively identify a swallowing issue in healthy older adults. Its implementation is expected to make a valuable contribution to the field of clinical practice and research conducted by Speech-Language Pathologists (SLPs).
- It would establish a foundational reference for subsequent evaluations and the timely identification of clinical dysphagia or the susceptibility to dysphagia.
- Once standardized, this questionnaire can find utility in diverse clinical settings nationwide and potentially integrate into a standardized protocol for appraising swallowing in older adults with good health.
- Moreover, the study's findings highlight the increasing severity of swallowing difficulties in the higher age groups, shedding light on the progressive nature of these challenges with advancing age. This information is crucial for healthcare

providers to tailor interventions and support systems for older adults, particularly those in the higher age brackets, to maintain optimal swallowing function and overall well-being.

Limitations

- The sample size was considerably lower than the sample size of other studies. Collecting larger samples could have enhanced the standardization of the tool.
- While the tool was developed and validated effectively, determining its diagnostic accuracy in terms of sensitivity (the ability to correctly identify individuals with swallowing disorders) and specificity (the ability to correctly identify individuals without swallowing disorders) would have added an important dimension to its assessment capabilities.
- The study lacked representation from individuals from varying socio-economic statuses.

Future Directions

- Conducting the test on a more diverse population is necessary for its standardization.
- It is recommended to assess the diagnostic accuracy of the adapted tool, including measures such as sensitivity and specificity.
- To establish the cut-off score for the questionnaire for accurate interpretation of SASQ-IE.
- It would be beneficial to explore the development of a concise and streamlined version of the SASQ-IE. While the current tool is comprehensive and valuable, a shorter version could be especially useful in clinical settings where time constraints are prevalent.

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APPENDIX A

Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE)

Part A: Demographic data

Name: **Age/Gender:**

Place of Residence: **Contact number:**

Medical history:

Socioeconomic status

Kuppusamy's socioeconomic scale score:

WHODAS 2.0 interpretation:

OPME:

Dental/ Oral history

Dentures: Present/absent

Missing teeth-

Oral hygiene- brushing twice a day and rinsing your mouth thoroughly after every meal **(Yes/No)**

Habits:

Habit of chewing/ smoking tobacco and/or consuming alcohol? **(Yes/ No)**

History/ Presence of Diabetes or Hypertension (yes/no):

Any known allergies:

Current diet plan (if any):

Part B: Questionnaire

Questions: To be administered by the professional.

Mark whether the symptoms present as- always, sometimes or never.

Domains	S.no	Questions	Never 0	Sometimes 0.5	Always 1
Activity Limitations	Q1	Do you have any difficulty with swallowing?			
	Q2	Have you made any changes in your diet due to swallowing difficulties? For example- eating mashed food instead of hard solids			
	Q3	Has the quantity of food eaten per meal reduced because of swallowing difficulty?			
	Q4	Have you lost weight over the years unintentionally due to reduced intake of food?			
	Q5	Have you stopped eating spicy food?			
Difficulties in Oral Phase, Pharyngeal Phase and Esophageal Phase	Q6	Do you have dry mouth?			
	Q7	Does your mouth feel dry while chewing or swallowing solid food?			
	Q8	Does food spill out of your mouth while eating or drinking?			
	Q9	Does water spill out of your mouth while eating or drinking?			
	Q10	Do you have trouble chewing solid food like Chakli, peanut barfi, etc?			
	Q11	Do you chew the food more slowly and carefully, taking longer time to complete the meal?			
	Q12	Do you find difficulty in moving food inside your mouth?			
	Q13	Do you find it difficult to initiate a swallow after the food is chewed?			

	Q14	Do you find food particles remaining in your mouth even after many swallows?			
	Q15	Do you cough/ choke/ clear your throat while/ before/ after swallowing? (mention when)			
	Q16	Do you cough/ choke/ clear your throat while watching TV/ mobile/ newspaper while eating?			
	Q17	Do you cough/choke/ clear your throat more often while you're talking to other people when eating?			
	Q18	Do you feel like that the food you ate is stuck in your throat? (specify consistency)			
	Q19	Do you think you need to swallow hard for it to go? (specify consistency)			
	Q20	Do you need to take water more often during meal time for the food to go into your stomach?			
	Q21	Do you feel the need to swallow many times to push the food into your stomach?			
	Q22	Do you frequently get burps with sour liquid or food coming back into your throat?			
Participation Restrictions	**Q23**	Do you avoid eating in public places due to difficulties in eating/drinking or swallowing?			
	Q24	Do you feel embarrassed/ uncomfortable to eat in social gatherings?			
	Q25	Do you feel upset that you are unable to eat like others?			

'Never' contains a score of 0, 'Sometimes' contains a score of 0.5 and 'Always' contains 1.

The scores for each question must be added up to obtain the Total SASQ-IE Score.

APPENDIX B

ALL INDIA INSTITUTE OF SPEECH AND HEARING, MYSURU-06

CONSENT FORM

Information to the participant/caregiver

I, Ms. Sruthi Mohandas, post- graduate student, as a part of my dissertation, am investigating the swallowing abilities in elderly Indian population by developing a screening questionnaire to screen for the same. The dissertation is titled "Development and Validation of the Swallow Abilities Screening Questionnaire for the Indian Elderly (SASQ-IE) under the guidance of Dr. Swapna. N, Head of Department of Department of Clinical Services, Professor of Speech Pathology and Coordinator-Centre for Swallowing Disorders, AIISH, Mysuru. This study has been taken up to help identify elderly individuals with swallowing difficulties due to the process of ageing and consequently improve their quality of life. The study involves undergoing screening procedures to identify swallowing difficulties. The procedure is unharming and has only research benefits and the participants will not receive any financial benefits from it. The improvement will be tracked using subjective tools and endoscopic measures. Some of the assessment sessions will be audio-video recorded and may be used for educational purposes including student training, presentation in seminars, and workshops and publication in journals. I therefore request you to participate in the present study with the assurance that your identity and this data will be kept confidential. There is no influence or pressure of any kind by the investigator or the investigating institute to your participation. Your kind co-operation in the study will go in a long way in helping us understand the swallowing deficits in ageing population and provide rehabilitation for the same.

Consent for participation

I have been informed about the aims, objectives, and the procedure of the study. The possible risk-benefits of my participation as human subject in the study are clearly understood by me. I will also be given the opportunity to ask questions about the study. Taking part in the study will include me answering questions regarding my swallowing function and undergoing a screening test of swallowing. I understand that I have the right to refuse participation as participant or withdraw my consent at any time. I am also aware that by subjecting myself to this study, I will have to give more time for assessments done by the investigator. The specific needs for the assessments, instructions and complications that may arise during this period have been explained to me and it is understood that investigator or the institute is not held responsible. I have the freedom to write to the AIISH Ethical Committee chairman in case of any violation of these provisions without the danger of me being denied of any rights to avail the clinical services at this institute. I hereby give my full consent for enrolling in the study.

I, _____, the undersigned, give my consent to be a participant for this study

Signature of the participant/caregiver Signature of the investigator

Name, address, and phone number: Date: