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"Aspiration pneumonia" A cause of concern in patients with cognitive disabilities - clinical Study at King Khalid University College of Dentistry- Abha-Saudi Arabia.

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Abstract:

Aspiration pneumonia is a significant cause of concern in people with disabilities. It is defined as the misdirection of oropharyngeal or gastric contents caused by dysphagia, accompanied by massive oral bacteria flora that invade the larynx and lower respiratory tract and produce an infectious response in the lungs. People with disabilities visiting for dental screening from a rehabilitation center are examined, and their oral health is reviewed and assessed for the risk factor for aspiration pneumonia with a simple chair-side water swallow test or incomplete salivary clearance. Data obtained and collected is evaluated in Excel sheet 2010 and subjected to required statistics (Chi-square test and Fisher's exact test) to compare the proportions of categorical variables. ANOVA (analysis of variance) and Kruskal-Walli's test are used to compare mean values of numerical variables between disability groups. This present study sought to determine the significance of several risk factors for dysphagia in persons with disabilities. Incidence of dysphagia was revealed in 12% of study subjects and poor oral hygiene was found to be a significant predictor of dysphagia severity. Further investigation is needed to determine the risk factors that showed an inconsistent significance between dysphagia and aspiration pneumonia.

The study is registered in the KKUCOD ethical committee SRC/REG/2018-19/30.

Keywords: Asp Aspiration pneumonia, Disability, Dysphagia, Oral

1. Introduction

Disability is a major social and economic medical issue in Saudi Arabia. Stroke, cerebral palsy, head and spinal cord injuries, infection, and inflammation are significant causes of mortality, hospitalization, and chronic disability in children [1]. A cognitive disability may be caused by consanguineous marriages, with an overall prevalence of 56% reported in Saudi Arabia, with first-degree cousin consanguinity (33.6%) being the most frequent compared to other relations (22.4%). Thus, genetic causes may be significantly associated with the risk of disabilities [2,3]. Aspiration pneumonia (AsP) is a misdirection of the oropharyngeal or gastric contents caused by dysphagia, accompanied by the massive influx of oral bacteria flora that invade the larynx and lower respiratory tract to produce an infectious response within the lungs· [4]. The key indicators of dysphagia are difficulty in initiating a swallow or delayed swallowing, difficulty forming food into balls (bolus formation) for swallowing, coughing, choking, nasal regurgitation, drooling, sore throat and hoarseness, dysarthria (difficult or unclear speech), halitosis (bad breath), and weight loss. Compromised consciousness, insufficient oral care, and decreased salivary clearance are also associated with the risk of developing AsP [5]. According to several studies, 7%–24% of community-acquired pneumonia is due to aspiration [5, 6]. Dysphagia is a complication of cranio-neurological injuries and diseases often seen in fragile older people due to the degenerative aging process, and aspiration pneumonia is one of the most critical complications and a major cause of death in patients with dysphagia [7]. Patients with dysphagia experience loss of sensation and mobility and paralysis or weakness of the affected side of the mouth and limbs, which hinder their activities of daily life, such as eating and tooth brushing. Furthermore, dry mouth can lead to multiple caries or severe periodontitis. The bacterial reservoir in the oro-pharyngeal area and the oral cavity may facilitate the invasion of the organisms into the trachea and lung tissues, which could lead to dysphagia and finally result in aspiration pneumonia[8] Dysphagia may be associated with

anatomical or neurological conditions, such as cerebral palsy, stroke, dementia, or Down's syndrome, which can affect everyday activities such as eating, drinking, and swallowing; additionally, a range of other causes, including behavioral aspects and those related to the use of medications have been identified[9]. Dysphagia screening is commonly performed by speech and language therapists using brief bedside tools (such as the water swallow test) and comprehensive assessments of the aspiration risk in patients with disabilities [10]. People with disabilities deserve the same opportunities to maintain oral health and hygiene as those without disabilities. Unfortunately, oral health care is one of the greatest unattended health needs of disabled people. Several studies have shown that the challenges in oral health are more complex among disabled people, who often cannot apply the techniques necessary to control plaque adequately [11,12]. In many instances, the disabled person would require the help of another person, such as the parent or guardian, who might be emotionally or intellectually incapable of dealing with the health problems of their less fortunate affiliates [12,13]. The level of oral hygiene is assessed using the Simplified Oral Hygiene Index (OHI-S) by Greene and Vermillion because it has been depicted as a sensitive and simple method for quantitatively assessing the oral hygiene of an individual or a group of people [14]. The OHI-S has two components: the simplified debris index (DI-S) and the simplified calculus index (CI-S). Each of these indices is based on numerical determinants representing the amount of debris or calculus on six preselected tooth surfaces [14, 15]. Dental caries and periodontal disease appear earlier in patients with physical and mental disabilities than in those without these disabilities. The inability to perform adequate oral hygiene might explain this population's high incidence of oral diseases [16]. Individuals with neuropathies prefer a pureed or pasty diet, which is more cariogenic [17]. However, other conditions, such as mouth breathing, occlusion abnormalities, bruxism, cariogenic diet, mastication and deglutition dysfunction, abnormal tension of facial muscles, reduced salivary flow, and effects of medications might contribute to the intellectual deficit and impaired

motor skills [18]. The decayed, missing, and filled teeth (DMFT) index, which comprises the number of decayed, missing, and filled teeth in an individual, is used to evaluate oral and dental health [19]. In most cases, oral hygiene is maintained by a parent or caregiver; however, they report difficulties because disabled persons are generally non-cooperative. Although the essential health, social, psychological, and educational needs of these disabled patients are identical to those of non-disabled individuals, the oral health of patients with special needs is feeble [20,21]. This study aimed to investigate the association between oral hygiene practices and dysphagia in subconscious patients with cerebral disabilities and syndromes in the community and to identify altered treatment modalities to prevent the development of AsP. The findings of this study may provide a basis for the early detection and prevention of AsP by investigating the associated risk factors, such as poor oral hygiene and incomplete clearance, which can lead to dysphagia and related factors in the disabled community.

2. Materials and Methods

2.1 Study design:

Informed consent was obtained from the conscious patient or the attendee after explaining the study. Ethical approval for the study was obtained from the scientific research committee of the College of Dentistry, King Khalid University (ref no: SRC/REG/2018/-19/30). The parallel design was used in this retrospective study comprising patients with known cerebral palsy, mental retardation, epilepsy, and dyslexia since birth.

2.2 Participants:

Patients from a local rehab center in the Abha-Asir province who were refractory to or showed limited success with physical medicine, dietary restrictions, and home care were selected via convenience sampling during their scheduled rehabilitation visits to the dental outpatient department at the College of Dentistry, King Khalid University, Saudi Arabia. The patients were assimilated and sorted out based on their gait, coordination, and

consciousness. Patients who are unconscious/uncooperative with a known history of pneumonia; those who were unwilling to cooperate with treatment instructions; and those patients with nasogastric intubation or bleeding tendencies and are on anticoagulation therapy; and those with chest congestion and breathing difficulties are excluded from the study. The oral health was reviewed and assessed for the risk factors for AsP.

2.3 Data Collection & Analysis:

Data collection was performed from December 2018 to May 2019 for six months from conscious and well-coordinated patients who were instructed to complete a self-administered symptom reporting questionnaire, and their functional status was recorded. The oral hygiene index -simplified (OHI-S) was used to assess oral hygiene as suggested by Green and Vermillion and Loe and Silness [14,19]. The oral health status was estimated indirectly using the DMFT and periodontal indices. The debris, calculus, and periodontal indices were used.

The instruments used for data collection included a well-illuminated dental unit with provision for a portable X-ray machine and a wheelchair, sterilized gloves, mouth masks, diagnostic kits, tongue blades, and bite blocks. The collected data was then examined for variables in the risk factor assessment for aspiration pneumonia. As described previously, Dysphagia or incomplete salivary clearance was measured using the simple chair-side water swallow test. The patient was instructed to sip a glass of water or juice, and signs of difficulty during swallowing, such as coughing, slow and effortful swallow or absent swallowing, rattling/gurgling after swallowing, bringing the liquid back up after swallowing, drooling of saliva, extrusion of food or liquid from the nose, having to take smaller sips of fluid, and watering of the eyes during drinking, were noted. The crude odds ratio (COR) was derived using the univariate logistic regression model [**9**]. The dependent variable used is the swallow test, and dysphagia as a predictable risk factor for AsP is considered, with variables having less disparity among its crude odd ratio.

3. Results

The data was evaluated using Microsoft Excel, 2010, and subjected to required statistical tests, such as the Chi-square test and Fisher's exact test, to compare the proportions of the categorical variables. One-way analysis of variance (ANOVA) and the Kruskal-Wally's test were used to compare the mean values of the numerical variables between the disability groups. The results were compared using the Chi-square test, and a p-value of <0.09 was considered statistically significant. Both univariate and multivariate regression models were estimated to assess the unadjusted and adjusted associations between the oral hygiene and health of the subjects and the oral care behaviors significantly associated with dysphagia. The adjusted odds ratios (OR) and 95% confidence intervals (CI) were reported for the multivariate analysis.

A total of 133 patients who presented with cognitive instability and could not perform their daily activities without the help of an external caregiver formed the study group. Among them, 93 subjects (82.3%) were cooperative and well-oriented to time and space and were, therefore, included in the study. 20 Subjects (17.6%) were Semiconscious/Disoriented/ to time and space and were excluded. Out of 93 subjects who were included, 68 subjects were males, and 25 subjects were female. The general characteristics, gender, age groups, orientation to surroundings, and consciousness status of the patients during clinical examination are shown in **Table 1**.

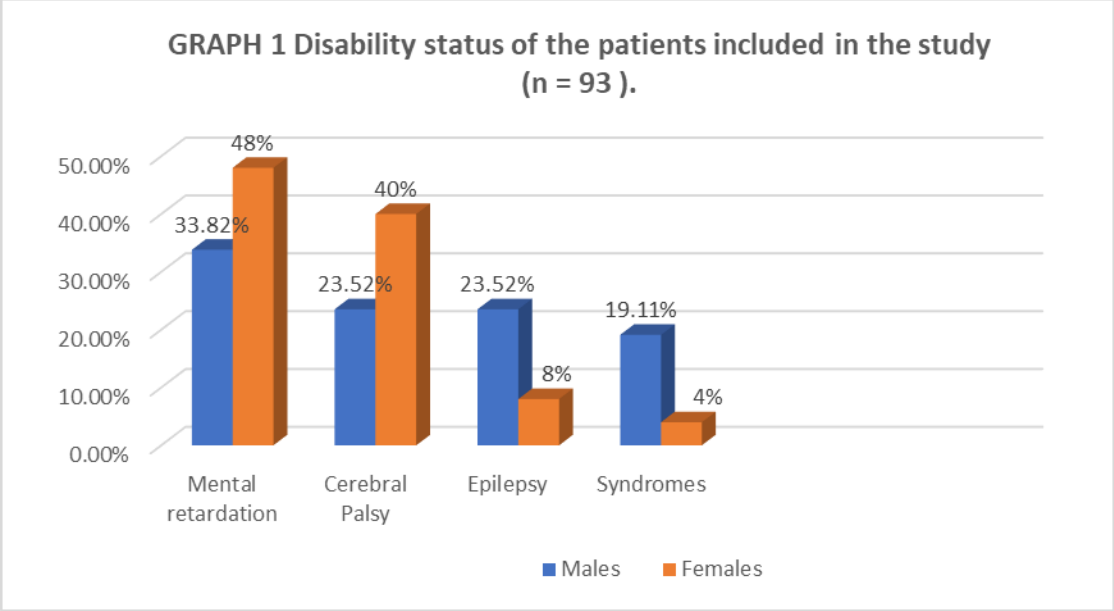
Table 1. Distribution of patients based on the age and characteristics (n = 93).

Terms	n = 93 (100%)	Age (years)			Orientation		Consciousness		
		10–20	21–30	31–40	Well-oriented	Disoriented	Conscious	Semi-conscious	Sedated
Male	68 (73.1%)	19 (27.9%)	20 (29.4%)	29 (42.6%)	43	25	43	19	6
Female	25 (26.8%)	7 (28%)	9 (36%)	9 (36%)	10	15	10	5	5
Sum	93 (100%)	26 (27.9%	29 (31.1%	38 (40.8%	53	40	53	24	11

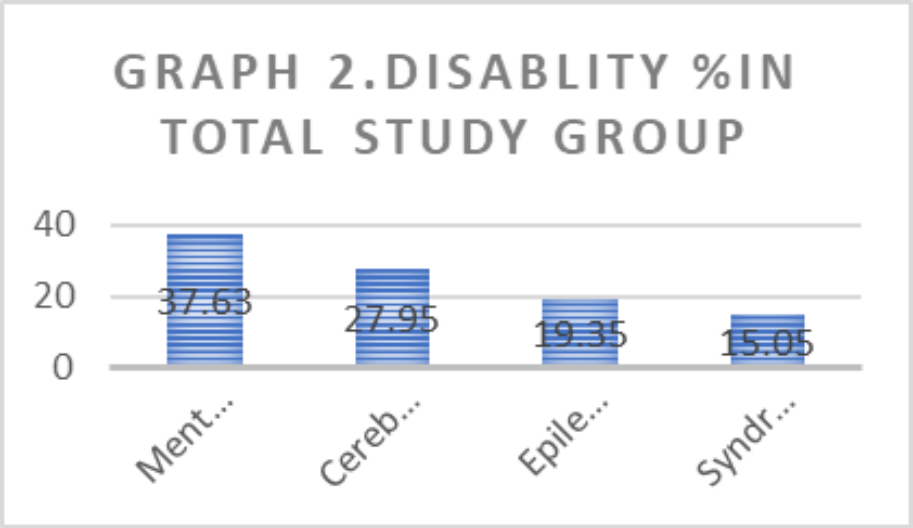
		)	)	)					
Aveg	46.5	13	14.5	19	26.5	20	26.5	12	5.5

univariate logistic regression model

Most patients were 31–40 years, followed by 21–30. The disability status of the patients was evaluated by examining their medical history and their physical and mental states of mind. The proportions of patients with mental retardation, cerebral palsy, and epilepsy were 37.63%, 27.95%, and 19.35%, respectively, whereas 15.05% of the remaining patients presented with other syndromes **Graph 1,2**.



Graph 2: Disability percentage in total study



The prime disability in this study was mental retardation, which was equally prevalent in both males and females, followed by cerebral palsy. The prevalence of epilepsy and other syndromes was higher in males than in females **Table 2**.

Tabel 2

Disability Status	Males	%	Females	%	Combined	Total%
Mental retardation	23	33.82%	12	48%	35	37.63
Cerebral Palsy	16	23.52%	10	40%	26	27.95
Epilepsy	16	23.52%	2	8%	18	19.35
Syndromes	13	19.11%	1	4%	14	15.05
Total	68	99.97%	25	100.00%	93	99.98
SD	4.24	0.06	5.56	0.23	9.28	0.099

univariate logistic regression model SD, standard deviation

Assisted brushing using a toothbrush and paste was the most prevalent oral hygiene practice among 83.87% of the patients, followed by other practices like using miswak or the finger to clean the teeth (16.12%). The COR ranged from 0.98 to 10.1, with a 95% CI of 404–497 in males and 183–223 in females **Table 3**.

Table 3. Oral hygiene practices in the study group.

OH-practice	Males	%	Female	%	Total	%	OR	95% CI
Brush	57	83.82%	21	84%	78	83.87%	0.98	Males
Others	11	16.17%	4	16%	15	16.12%	10.1	404–497
Total	68	99.99%	25	100%	93	99.99%		Females
Median	34	0.49	12.5	0.5	46.5	0.49		183–223
SD	32.52	0.47	12.02	0.48	44.54	0.47		

OH, oral hygiene; SD, standard deviation; OR, odds ratio; CI, confidence interval

Proper treatment was provided to 93 (69.92%) patients who presented with adequate mouth opening. The remaining 40 (30.07%) patients were deemed unsuitable for treatment due to inadequate or restricted mouth opening because of their hyper-anxious or semi-conscious states of mind. **Table 4.**

Table 4. Description of patients with adequate and inadequate mouth opening.

	Mouth opening		
	Adequate (%)	Inadequate (%)	Total
Males	68 (51.12)	25%	93
Females	25 (18.76)	15%	40
Total	93 (69.92)	40%	133
Median	46.5 (34.94)	20%	
SD	30.40 (22.88)	7.071	

The debris index was shallow in 53 patients (56.98% ± 0.24%) examined in this study, indicating inadequate brushing habits and the need for oral prophylaxis as the first-line treatment. Likewise, the calculus indices were poor in 40 patients (43% ± 0.18%), thus indicating the poor oral hygiene status and the need for treatment in these individuals. The ANOVA regression analysis for the oral hygiene index score in males and females was 46.5 (total median score, 20+ 26.5), indicating poor grading (<p = 0.05). These findings indicated the need for oral prophylaxis as the first line of treatment **Table 5**.

Table 5. Oral hygiene index-simplified in the study group. DEBRIS INDEX

Debris index	**Male**	**%**	**Female**	**%**	**Total score**	**Total %**
Good	0	0%	0	0%	0	0%
Fair	12	17.64%	0	0%	12	12.90%
Poor	22	32.35%	6	24%	28	30.10%
Very poor	34	50%	19	76%	53	56.98%
Total	68	0.999	25	100	93	0.999
Median	17	0.2499	3	0.12	20	0.215
SD	14.4683	0.212774	8.95823	0.35832	22.9110	0.24631
Calculus index	**Male**	**%**	**Female**	**%**	**Total score**	**Total %**
Good	0	0%	0	0%	0	0%
Fair	19	28%	3	12%	22	23.65%
Poor	27	39.70%	13	52%	40	43%
Very poor	22	32.35%	9	36%	31	33.33%
Total	68	0.9999	25	100%	93	0.999
Median	20.5	0.301	6	0.24	26.5	0.284
SD	11.8039	0.17356	5.8523	0.23409	17.1537	0.1844

The mean DMFT in the study group was 21.65 (95% CI, 1.8–16.27), and the components that most contributed to the high DMFT were filled (11.4) and decayed (5.55) teeth, which are not correlating in the literature study with Lukacs [29] The mean DMFT was found to be higher in males (16.32) than in females (5.33). Spearman's rank correlation coefficient (r = 0.951) revealed a significant but weakly positive correlation between males and females concerning the DMFT (p > 0.09) **Table 6**.

Table 6. DMFT index in the study group (n = 93).

	Males	**Females**	**Combined**
Decayed	3.85	1.70	5.55
Missing	3.37	1.33	4.70
Filled	9.1	2.3	11.4
DMFT Score	16.32	5.33	21.65
p-value	0.02	0.01	0.03
Median	3.85	1.7	5.55
SD	3.17	0.48	3.64
Mean DMFI	16.32	5.33	21.65
95% CI	2.45–13.33	2.992–0.560	1.8–16.27

CI, confidence interval

31 patients (33.33%) experienced bleeding from the gums, and 44 patients (47.31%) presented with pockets that were >3 mm in depth (p = 0.104; OR, 2.175; 95% CI, 115–228). Furthermore, 19% of the patients had no gingival or periodontal conditions; thus, they were considered for the risk assessments for AsP **Table 7.**

Table 7. Periodontal status of the patients in this study.

Score	Males	%	Females	%	Total	Total%	OR	p-value	CI
0 (healthy)	13	19.11%	5	20%	18	19.35%			
1 (bleeding)	24	35.29%	7	28%	31	33.33%	1.402		
Pocket >3 mm	31	45.58%	13	52%	44	47.31%	0.773		
Total	68	99.99%	25	100%	93	99.99%	2.175	0.104	115–228
SD	9.073	0.133	4.163	0.1773	25.026	0.1398			

OR, odds ratio; CI, confidence interval; SD, standard deviation

Out of the 93 patients examined in the study, 81 (87.09%; COR, 1.4) successfully swallowed one glass of water and one whole biscuit without displaying signs of dysphagia **Table 8**.

Table 8. Swallow test

	Males (n = 68)	Females (n = 25)	COR	n = 93	N/A (n-N)	Mean	95% CI
One glass water/one biscuit	60	21	1.4	81	52	45.5	240.39–331.38
Half a glass of water	5	2	0.47	7	126	6	6.70–18.70
Half a biscuit	3	2	0.47	5	128	2.5	3.85–8.85
Total	68	25	0.9	93	40	54	

COR, crude odds ratio; CI, confidence interval; n, number of patients

The remaining 12 (12.9%; COR, 0.9) patients could consume only half a glass of water and half a biscuit with feelings of obstruction in the throat and displaying various signs of dysphagia. The 95% CI in patients with symptoms of dysphagia ranged between 3.8 and 18.7, indicating the significance of the swallow test [9]. COR values are less than 1 (0.7) for drooling, thick saliva, effortful swallowing, rattle sound after swallowing, cough, and intake of small sips; hence, they were considered contributory factors for dysphagia and risk factors for AsP. The study viewed variables such as halitosis, dry mouth, and restricted mouth opening as contributing factors to poor oral hygiene. The risk factors for developing AsP were considered dependent variables for dysphagia among those with cognitive disabilities **Table 9.**

Table 9. Predictable risk factors for aspiration pneumonia among the patients with cognitive disabilities (n = 93).

Variables	**Halitosis**	**Drooling**	**Dry mouth**	**Restricted mouth opening**	**Thick Saliva**	**Effortful swallowing**	**Rattle**	**Cough**	**Small sips**
Males	60	8	45	8	8	8	8	8	8
Females	21	4	21	15	4	4	4	4	4
COR	1.42	0.7	0.37	0.88	0.7	0.7	0.7	0.7	0.7
SD	33.23	0.70	18.38	15.55	1.41	1.41	3.53	3.53	3.53
Mean	40.5	6	33	11.5	6	6	6	6	6
95% CI (range)	247 (207–288)	25 (19–31)	152 (119–185)	44 (32–55)	25 (19–31)	25 (19–31)	25 (19–31)	25 (19–31)	25 (19–31)
p-value	0.007	0.002	0.001	0.018	0.008	0.008	0.001	0.008	0.008

CI, confidence interval COR crudes odd's ratio

This study demonstrated significant dysphagia variables in 21 to 30 years of age in both male and female subjects with a p-value of 0.09 and COR of 1.5, followed by 31 to 40 years **Table 10**.

Table 10. Demonstration of Age and Sex-related dysphagia variables

Age	**Males**	**Female**	**Total**	**COR**
10–21 years	15	4	19	3.75
21–30 years	30	12	42	1.5
31–40 years	20	8	28	2.5
41–50 years	3	1	4	3
Total	68	25	93	2.72
95% CI	27.34	11.86	25.37	
CI range	8.6–18.6	5.61–18.11	44.3–95.12	
p-value	0.01	0.02	0.02	

COR, crude odds ratio; CI, confidence interval

Risk factors for developing AsP are considered dependent variables of developing dysphagia among people with cognitive disabilities. The COR in subjects with dysphagia is a disparity between ages 10-21 and 41- 50 years (COR 3.75 & 3). The OR for dysphagia in this study was 2.72 (95%CI, 44.3–95.12; $p < 0.09$). Based on these findings, dysphagia was considered the most prominent risk factor for the development of AsP among young adults and middle-aged patients with cognitive disabilities, which correlates with the study conducted by Eslick [8]. The demographic characteristics of patients with dysphagia and their disease states, consciousness, and dependence on activities are summarized in **Table 11.**

Table 11. Demographic characteristics of disabled subjects with dysphagia.

Variables	Terms	N	Yes (n = 93)	No (N= 40)	p-value
Patients			n%	n%	
Gender	Males	68	73.11%	26.8%	0.19
	10–21 years	15	10 (66.66)	5 (33.33)	
	21–30 years	30	20 (66.66)	10 (33.33)	
	31–40 years	20	10 (50)	10 (50)	
	41–50 years	3	3 (100)	0	

	Females	25	26.88%	15%	0.05
	10–21 years	4	4 (16)	0	
	21–30 years	12	10 (40)	2 (8)	
	31–40 years	8	7(28)	1 (4)	
	41–50 years	1	1 (4)	0	
	p-value	0.019	0.058	0.181	
	COR	1.63	7.40		
	95% CI	273.18			
	CI range	226–319			
Disease			Males	Females	0.02
	Mental retardation	35	23 (65.71)	12 (34.38)	
	cerebral palsy	26	16 (61.53)	10 (38.46)	
	Epilepsy	18	16 (88.88)	2 (11.11)	
	Syndrome	14	13 (92.85)	1 (7.14)	
Consciousness			Males	Females	
	Conscious	93	68 (73.11)	25 (26.88)	
	Sedated	40	25 (62.5)	15 (37.5)	
Dependence on activities			Males	Females	
	Completely	40	25	15	
	Partially	93	68	25	

COR, crude odds ratio; CI, confidence interval, number of patients showing positive result, N total number of patients

Multiple logistic regression analysis for dysphagia symptoms showed that 74 (79.56%) patients were affected by dysphagia (p = 0.04 and 0.03 for males and females, respectively; **Table 12**).

Table 12. Multiple logistic regression analysis for dysphagia symptoms.

Age	Sex		Total	
	Males	Females		OR
	n = 68 (51.12%)	n = 25 (18.79%)	N = 93 (100%)	
10-20	15	4	19	1.809
21-30	30	12	42	0.883
31-40	20	8	28	0.427
41-50	3	1	4	0.435
Total no patients with dysphagia	N=68 (73.11%)	n=225 (26.8%)	74 (79.56%)	
SD	9.06	4.74	13.16	
95% CI	11.25	5.88	16.34	
CI range	1.45–21	088–10	1.5–31	
p-value	0.04	0.03		
OR odds ratio, SD standard deviation, CI confidence intervel				

4. Discussion

This study aims to demonstrate the relationships among the variables of dysphagia, the demographic distribution, and the oral hygiene and health status of patients with cerebral disabilities in a province in Saudi Arabia. According to the Economic Bureau of the Kingdom of Saudi Arabia, more than 50% of people with physical disabilities are from rural areas and above the age of 60 [2]. In the current study, most patients with physical disabilities belonged to the 21–40 age group (75.26%). Mental retardation (37.63%), cerebral palsy (27.95%), and other syndromes (15.05%) were identified as the major causes of cognitive disability in this study. However, epilepsy (19.35%) was not considered as an individual entity for disability because it manifested as secondary to other primary disability conditions in this study.

Oral disease represents a significant health problem among individuals with disabilities, and the prevalence and severity of oral disease among disabled groups are higher when compared to the general population. Poor oral hygiene, impairment of cognition, paralysis of the extremities, inability to express suffering, immobility, and dysphagia play essential roles as risk factors for AsP [22]. The patients in the current study had disabilities and could not perform the activities of daily life; their daily health care, including oral health, was provided mainly by caregivers. More than 83.87% of the patients received oral care via toothbrushing, whereas 16.12% used the miswak stick or the finger rather than the brush. The finger or miswak does not entirely remove the dental plaque from the gingival sulcus, interproximal areas, palatal mucosa, and oropharyngeal areas. Thus, the accumulation of colonized pathogens could serve as a reservoir for recurrent lower respiratory tract infections in these patients [23]. Our results showed that subjects who brushed their teeth with miswak or the finger were at a higher risk of developing AsP than those who used the toothbrush. Improper use of oral care tools could pose a risk factor for AsP. Inadequate toothbrushing after meals or before going to bed at night will result in the attachment of food and debris to the teeth, much-buccal folds, palate, base of the tongue, and other oropharyngeal areas; subsequently, fermentation of this

debris in the mouth during sleep will lead to bacterial accumulation and the development of dental plaque, which might eventually lead to the risk of AsP **[**23]**.**

In the current study, assisted tooth brushing was ineffective in disabled patients with limited mouth opening and those with agitated and sedated states of mind. The patients' oral hygiene demonstrated a tendency toward the poor OHI-S category (42.85%). Similarly, the debris index was inferior in 50% of males and 76% of female patients, while the calculus index was in the poor category in 39.70% of males and 52% of females. The mean DMFT was higher in males (16.32) than females (5.33); this finding is not consistent with that reported in the literature, wherein the incidence of dental caries was more common in females than males [24,19].

The component that most contributed to the high DMFT in the present study was filled teeth, followed by decayed teeth. In a previous national population survey, caries rates among the disabled population were higher than those in the general population for all the age groups examined [25]. Children with disabilities tend to have more decayed and missing teeth and higher incidences of poor gingival health than those without disabilities [25,26]. The periodontal status of the patients was evaluated using the Loe and Silliness index for periodontal pockets [19,24]. Seventy-five (80.64%) patients had bleeding from the gums with pockets that were >3 mm in depth. The most significant factor in improving the oral health status of disabled patients might be the level of awareness of their family members or caregivers about the importance of oral hygiene and oral hygiene practices.

Previous studies have reported that the risk of dysphagia increases with age, mainly due to the age-related decline in muscle strength and degeneration of nerve conduction velocity **[27]**. Additionally, oropharyngeal dysphagia, malnutrition-led impaired resistance to infections, and poor oral health are reported to be associated with AsP **[27,28]**. These findings were corroborated in the current study. Variables like drooling, thick saliva, effortful swallowing, rattling sound, cough reflex, and taking small sips are thought to be associated

with dysphagia and AsP. Twelve patients (12.9%; COR, 0.9) in the present study consumed half a glass of water and half a biscuit and displayed various signs of dysphagia, including a feeling of obstruction in the throat. The confidence interval in the subjects with variables for dysphagia is in the range of 3.8 to 18.7. This huge variance suggests the significance of the swallow test [9]. Studies conducted by Lukas and Leroy [29,30] concluded that alterations in saliva might be related to the risk of AsP; this may explain why patients with dry mouths presented with a lower risk for AsP compared to those with halitosis and restricted mouth opening in the present study. Variables with a COR of <1 (0.7), such as drooling, thick saliva, effortful swallowing, rattle sound after swallowing, cough, and intake of small sips, were considered contributory factors for dysphagia and, thereby, the risk factors for AsP. Alternatively, variables like halitosis, dry mouth, and restricted mouth contributed to poor oral hygiene. Risk factors for developing AsP are considered dependent variables of developing dysphagia among people with cognitive disabilities. Hence, in the present study, the swallow test proved effective in identifying dysphagia among subjects with cognitive disabilities. Patients needing partial assistance in their daily life experienced higher risks for dysphagia, especially those in the 21–30 age group (p = 0.009; COR, 1.5), thus implying that the maintenance of physical functioning is essential for effective swallowing. The incidence of dysphagia ranges from 51% to 84% in cerebrovascular accident patients and those with Parkinson's disease and Alzheimer's disease [8,9]. Leviton FJ connected the high incidence of pneumonia with dysphagia associated with aspiration in stroke patients [31]. In the study by Falsetti, dysphagia was observed in more than a third of the stroke patients in rehabilitation wards, and 26.5% of these patients developed AsP [21,28]. In the current study, the incidence of dysphagia was 12% with a COR of 3.8–18.7, which could be associated with total subjects consisting of poor oral hygiene. The CORs in patients with dysphagia are in a disparity between ages 10-21 and 41- 50 years (COR 3.75 & 3). The OR for dysphagia in the patients was 2.72 (95% CI, 25.37, 44.3–95.12; p < 0.009; therefore, it was considered the most prominent risk factor for developing AsP in

young adults and middle-aged subjects with cognitive disabilities.

5. Conclusion

This study sought to determine the significance of several risk factors for dysphagia in persons with disabilities. The incidence of dysphagia was 12%, and poor oral hygiene was found to be a significant predictor of dysphagia severity. Our findings indicate that poor oral hygiene could be an essential factor in predicting the risk of AsP. The use of inappropriate cleaning tools can lead to poor oral health conditions and increase the risk of pneumonia in disabled persons. Educating the support workers and caregivers with the help of a speech and language therapist on how to modify the diet and provide adequate care during feeding and tooth brushing can help to reduce the risk of AsP.

5.1: Limitation:

One of the limitations of this study is the findings cannot be generalized to the whole population because it was conducted among young adults in a regional rehabilitation centre. Moreover, the results cannot be interpreted as indicating a causal relationship owing to the cross-sectional design. Thus, further studies using a larger and more comprehensive sample size are required to confirm the findings of this study. Moreover, further investigations like Barium meal are needed to determine and demonstrate inconsistent significance between dysphagia and AsP.

5.2: **Future implications**:

Good oral health practices should be implemented in disabled people. Regular dental check-ups, at least once per year, are advised to monitor oral health and identify disease development early. Advances in exceptional care dentistry should be encouraged to promote oral health in people with disabilities. Furthermore, it is crucial to educate the dental team to provide mainstream care for people with cognitive disabilities. Thus, training undergraduates and including this information in the primary curriculum would help them confidently manage the routine dental care of people with disabilities. Researchers should aim to enhance oral health and deliver patient care to these underprivileged

members. Additionally, the methods used to assess the levels of need must be improved through dental and epidemiological surveys.

6. **Abbreviations** AsP: Aspiration Pneumonia; OHI-S: Oral hygiene Index Simplified DI-S: Debris index; CI-S: Calculus index; COR: Crude odd's ratio.
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8. **Authors' contributions**

   Conceptualizations, SMK, AAQ, HM. Methodology, SMK, MA, MSH, ZK; Software, SDA and ZK. Validation, SDA, MA, MSH, and ZK. Formal analysis, SMK, and AAQ; Investigation, SDA and KA, Resources HM, MA, MSH and SAAA.; Data curation, SMK and KA; Writing—original draft preparation, SMK, MSH and KA Writing—review and editing, LA, RS, SAAA, Supervision, SN, SAAA. Project administration, SMK and AAQ.

   All authors have read and agreed to the published version of the manuscript and gave final approval to publish, and have agreed on the journal to which the article has been submitted and to be accountable for all aspects of the work.

9. **Institutional Review Board Statement:**

   This study was approved by the Institutional Review Board (or Ethics Committee) of the King Khalid University College of Dentistry (protocol code SRC/REG/2018/-19/30). The treatment was standard without any experimental approach.

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11. **Informed Consent Statement:**

    Informed consent was taken by the caregivers attending the patient to complete

the questionnaire and do the required treatment.

12. Data Availability Statement:

Supporting data used and analysed during the current study are available from the corresponding author upon reasonable request.

13. Conflicts of Interest: The authors declare no conflict of interest

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