Universitas
ODONTOLOGICA

Vol. 40
Rolling volume, January-December
2021

ISSN: 2027-3444 (online) | ISSN: 0120-4319 (print)

Artículos

Description of Swallowing and Chewing Processes in Adults with Down Syndrome: An Exploratory Review*

Descripción de los procesos de deglución y masticación en adultos con Síndrome de Down: Revisión Exploratoria

Descrição dos processos de deglutição e mastigação em adultos com síndrome de Down: uma revisão exploratória

DOI: https://doi.org/10.11144/Javeriana.uo40.dscp

Lorena Ester Sepúlveda Vega [a]
Universidad del Museo Social Argentino, Argentina
lorenasepulvedavega@gmail.com
ORCID: https://orcid.org/0000-0002-4868-9367

Pablo Méndez
Universidad de Buenos Aires, Argentina
Universidad del Museo Social Argentino, Argentina
pablomartinmendez@hotmail.com
ORCID: https://orcid.org/0000-0001-5013-1680

Patricia Vázquez Fernández
Universidad del Museo Social Argentino, Argentina
patricia.vazquez.fernandez@umsa.edu.ar ORCID:
https://orcid.org/0000-0001-7029-6669

Received: 11 october 2021
Accepted: 09 december 2021
Published: 15 december 2021

Abstract:

Background: Down syndrome is the most prevalent genetic condition among people with disabilities. Given the increased life expectancy of these patients, it is important to improve their general and oral health conditions in adult life. During this stage of their life cycle, effects of aging such as loss of muscle mass, strength, and coordination, are added to their condition, which also impacts the stomatognathic system and causes alterations in vital functions such as swallowing and chewing. **Purpose:** To explore and describe the characteristics of the orofacial functions of swallowing and chewing in adults with Down syndrome. **Methods:** A search for titles was performed in the PubMed, LiLACS and SciELO databases. The terms and Boolean operators used were (down syndrome) AND (feeding disorders); (down syndrome) AND ((deglutition disorders) OR (dysphagia)); and (down syndrome) AND ((chewing disorders) OR (masticatory dysfunction)). **Findings:** The search yielded 82 articles and, after carrying out a selection process, 11 articles were included to prepare the review. **Conclusions:** Adults with Down syndrome have anatomical and functional features that affect the chewing and swallowing processes. Likewise, the characteristics of the food can also influence the performance of both orofacial functions. It is recommended to study, in future research, the parental or caregiver perspectives of swallowing and chewing of adults with Down syndrome to determine how they influence the feeding process and identify the actions they perform to facilitate this process.

Keywords: adults, chewing, dentistry, disability, Down syndrome, mastication, oral medicine, orofacial functions, special patient, swallowing.

Resumen:

Antecedentes: El síndrome de Down es la condición genética más prevalente entre las personas con discapacidad. Dado el aumento en la expectativa de vida de estos pacientes, resulta importante mejorar sus condiciones de salud general y oral en la vida adulta. Durante esta etapa del ciclo vital se suman a su condición efectos propios del envejecimiento como pérdida de masa muscular, fuerza y coordinación, lo que impacta también el sistema estomatognático y causa alteraciones en funciones vitales como la deglución y la masticación. **Objetivo:** Explorar y describir las características de las funciones orofaciales de deglución y masticación en adultos con síndrome de Down. **Métodos:** Se realizó una búsqueda electrónica en las bases de datos de PubMed, LiLACS y SciELO. Los términos y operadores boleanos utilizados fueron (down syndrome) AND (feeding disorders); (down syndrome) AND ((deglutition disorders) OR (dysphagia)); y (down syndrome) AND ((chewing disorders) OR (masticatory dysfunction)). **Resultados:** La búsqueda arrojó 82 artículos y, luego de realizar un proceso de selección, se incluyeron 11 artículos con los que se elaboró la revisión. **Conclusiones:** Los adultos con síndrome de Down presentan rasgos anatómicos y funcionales que afectan los procesos de masticación y deglución. Asimismo, las características de los alimentos también pueden influir en el desempeño de

Author notes

Authors' Note:[a] **Correspondence:** lorenasepulvedavega@gmail.com; pablomartinmendez@hotmail.com ; patricia.vazquez.fernandez@umsa.edu.ar

ambas funciones orofaciales. Se sugiere estudiar, en futuras investigaciones, las perspectivas parentales o del cuidador de la deglución y masticación de adultos con síndrome de Down para determinar cómo influyen en el proceso de alimentación e identificar las acciones que ejecutan para facilitar este proceso.
Palabras clave: adultos, deglución, discapacidad, funciones orofaciales, masticación, medicina oral, odontología, paciente especial, síndrome de Down.

Resumo:

Antecedentes: A síndrome de Down é a condição genética mais prevalente entre as pessoas com deficiência. Diante do aumento da expectativa de vida desses pacientes, é importante melhorar suas condições gerais e de saúde bucal na vida adulta. Nessa fase do ciclo de vida, somam-se à sua condição efeitos do envelhecimento como perda de massa muscular, força e coordenação, que também impacta o sistema estomatognático e provoca alterações em funções vitais como deglutição e mastigação. **Objetivo:** Explorar e descrever as características das funções orofaciais de deglutição e mastigação em adultos com síndrome de Down. **Métodos:** Foi realizada busca de títulos nas bases de dados PubMed, LiLACS e SciELO. Os termos e operadores booleanos utilizados foram (síndrome de down) AND (distúrbios alimentares); (síndrome de down) AND ((distúrbios da deglutição) OR (disfagia)); e (síndrome de down) AND ((distúrbios da mastigação) OR (disfunção mastigatória)). **Resultados:** A busca resultou em 82 artigos e, após a realização de um processo de seleção, 11 artigos foram incluídos para elaboração da revisão. **Conclusões:** Adultos com síndrome de Down apresentam características anatômicas e funcionais que afetam os processos de mastigação e deglutição. Da mesma forma, as características dos alimentos também podem influenciar no desempenho de ambas as funções orofaciais. Recomenda-se estudar, em pesquisas futuras, as perspetivas dos pais ou cuidadores sobre a deglutição e mastigação de adultos com síndrome de Down para determinar como influenciam o processo de alimentação e identificar as ações que realizam para facilitar esse processo.
Palavras-chave: adultos, deficiência, deglutição, funções orofaciais, mastigação, medicina oral, odontologia, paciente especial, síndrome de Down.

INTRODUCTION

Down syndrome is the most common genetic cause of disability. A study in the United States reported a prevalence of 8.27 per 10,000 live births (1), while in Latin America, according to the Latin American Collaborative Study of Congenital Malformations (ECLAMC), a prevalence of 1.88 per 1,000 births of Down Syndrome has been reported. This study reports that in Chile a rate of 2.47 per 1,000 births alive is described, while in Argentina this figure reaches 2.01 per 1,000 births. In Bolivia, Brazil, and Colombia, the rates correspond to 1.55, 1.72, and 1.72 per 1,000 live births, respectively (2). The life expectancy of persons with Down syndrome has increased to an average of 60 years, with 25 % over 63 years of age (3), which is why paying attention to the conditions that this population may present in adulthood becomes more necessary.

Longitudinal studies have reported there is a process of premature aging associated with this syndrome, beginning at around 50 years of age (4) and, along with this, a greater risk of developing of Alzheimer-type dementia (5,6). Therefore, a high percentage of people with Down syndrome have experienced difficulties while drinking and eating, which can lead to life-threatening conditions, such as malnutrition, dehydration, and aspiration pneumonia, compromising swallowing and general nutritional status (7).

The aging process in a person with Down syndrome, as in people with normal development, causes changes in the structure, strength, coordination, and sensitivity of the swallowing mechanism, which can impact the intake of food with different consistencies. It prompts a decrease in skeletal muscle mass, including orofacial muscles, leading to reduced mobility and greater rigidity associated with the connective tissue within the muscles, causing a slower and more insecure passage of the bolus through the oropharynx. The difference between an adult with neurotypical development and an adult with Down syndrome is the adult without the syndrome could compensate for the change processes that they experience at a functional level (6). Because of the above, psychosocial consequences, eating disorders, and speech disorders may occur (8).

Considering the argument above, the following research question was formulated: What are the characteristics of the orofacial functions of swallowing and chewing in adults with Down syndrome? To

answer this question, an exploratory review of literature was proposed to investigate and describe the characteristics of these orofacial functions in adults with Down syndrome.

MATERIALS AND METHODS

Search Strategy and Databases

Three advanced electronic searches for titles were carried out during September 2021 in the following databases: PubMed, LiLACS and SciELO, using the following key terms and Boolean operators. Table 1 shows the searches.

TABLE 1
Title Searched Carried out in PubMed, LiLACS y SciELO

Searches\Database	PubMed	LiLACS	SciELO
Searches	• Search 1: (Down Syndrome AND Deglutition disorders OR Dysphagia) • Search 2: (Down Syndrome and feeding disorders) • Search 3: (down syndrome) AND ((chewing disorders) OR (masticatory dysfunction))	• Search 1 (Down Syndrome AND Deglutition disorders AND Dysphagia) • Search 2 (Down Syndrome and feeding disorders) • Search 3: (down syndrome) AND ((chewing disorders) OR (masticatory dysfunction))	• Search 1 (Down Syndrome AND Deglutition disorders OR Dysphagia): • Search 2 (Down Syndrome and feeding disorders) • Search 3: (down syndrome) AND ((chewing disorders) OR (masticatory dysfunction))

Source: the authors.

Eligibility Criteria

As inclusion criteria, articles with primary data, in English or Spanish language, referring to swallowing and chewing disorders in adults with Down syndrome, that is, older than 18 years of age, were considered. Studies published between 2000 and 2021 were included. Bibliographic or systematic reviews were excluded.

Record of Studies and Synthesis of Findings

The titles and abstracts of all the articles initially identified were read and then screened considering the inclusion and exclusion criteria, as well as the purpose, methodology, population assessed, and findings of each study. The resulting pool of titles, excluding those whose topic was not related to our research question, were read in full. Once we obtained the final sample, we consolidated and collected the data, and classified the articles according to themes, to address each of the aspects that served to respond the research question.

RESULTS

Study Selection

Figure 1 presents a flow chart with the steps to identify and select studies. The initial search generated 82 titles and, after removing 11 duplicates, 71 articles were obtained to evaluate in the screening stage. Subsequently, the titles and abstracts of the studies found were read and 55 articles were eliminated, as they were not related to the subject of the review. Therefore, 16 were considered for full reading. Finally, the sample for the Review consisted of 11 articles (Table 2).

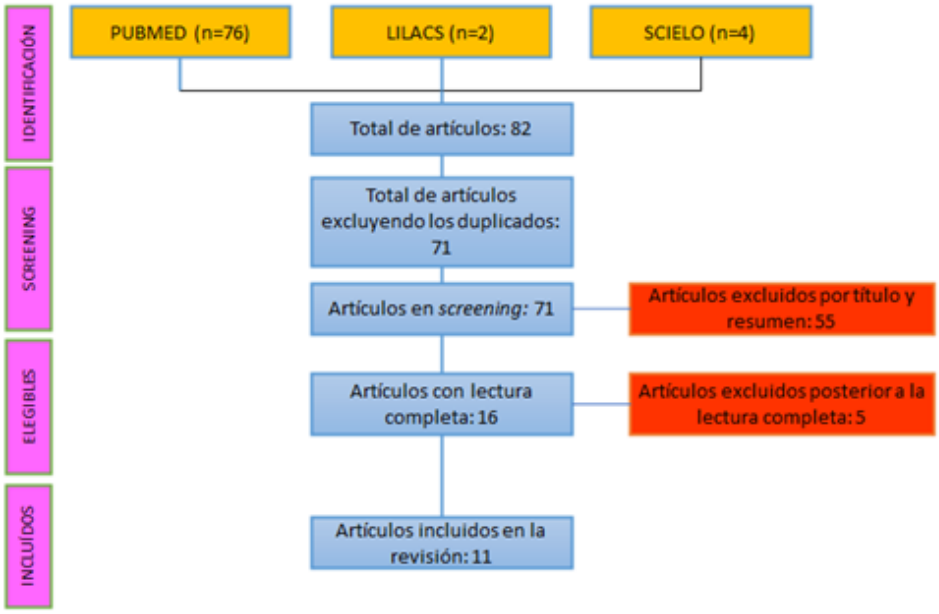

FIGURE 1
Flowchart of the identification and selection process
Source: the authors.

TABLE 2
Main Characteristics of the Studies Selected

Article	Sample/Country	Participants	Methods	Outcome Assessed
Hashimoto M, *et al.*, 2014 (9)	People with Down syndrome, 20-35 years of age. Japan	Nine 20-35-year-old males with Down syndrome. Regular patients of Tohoku University Hospital, Japan. Control group: 10 24-30-year-old healthy volunteers.	Quasi-experimental design.	Characteristics of pressure exerted by the tongue against the hard palate during swallowing.
Smith CH, *et al.*, 2014 (10)	People with Down syndrome, 20-50 years of age. Singapore	10 males and 13 females with Down syndrome, ages 20-50 years, residents of a care facility in Singapore.	Observational study.	Observation of oral feeding in a group of adults with Down syndrome regarding eating and drinking behaviors, as well as those during oral and pharyngeal stages.
Zárate N, *et al.*, 2001 (11)	People with Down syndrome, 5-38 years of age. Singapore. Spain	58 3-58-year-old patients with Down syndrome (22 females, 36 males) and 38 21-61-year-old healthy individuals.	Clinical assessment. Tests: dysphagia for liquids and solids, heartburn, vomiting/regurgitation, chest pain. Esophageal function.	Prevalence and form of presentation of motor, esophageal dysfunction in individuals with Down syndrome
Allison PJ, *et al.*, 2004 (12)	People with Down syndrome, average age 31.6±8.5 years. France	Five females and six males with Down syndrome, average age 31.6+8.5. Control group with 5 females and 7 males, healthy and average age 22.9+6.6 years.	Clinical assessment of chewing process through video recording.	Validation of video assessment of chewing in individuals with Down syndrome.

TABLE 2 (CONT.)

Hennequin M, *et al.*, 2015 (13)	People with Down syndrome, average age 28.5±9.3 years. France	14 adults with Down syndrome, average age 28.5±9.3 years. Control group: 20 individuals, average age 24.6+1 years.	Quasi-experimental longitudinal, controlled, non-randomized study.	Whether increasing inter-maxillary contacts improves chewing effectiveness.
Thacker A, *et al.*, 2008 (14)	Caregivers of adults with learning challenges. UK	2000 caregivers of adults with learning challenges.	27- question survey mailed through the postal service.	Risk factors in adults with intellectual disability and history of choking.
Chenbhanich J, *et al.*, 2019 (15)	21-68-year-old adults with Down syndrome. US	37 adults with Down syndrome who were patients of the Metrowest Medical Center for 10 years.	Retrospective study of 10-year records.	Comorbidities and reasons for hospitalization of people with Down syndrome.
Bermudez BEBV, *et al.*, 2019 (16)	187 0-5-year-old, 442 6-10-yo, 427 12-20-yo, 98 21-30-yo, and 53 31-plus-yo people with Down syndrome. Brazil	1200 clinical records of patients with Down syndrome who were seen between 2005 and 2015 at the Hospital of the Federal University of Paraná.	Retrospective, observational, and cross-sectional study.	Prevalence of gastrointestinal disorders in people with Down syndrome in a 10-year period.
Pinheiro DLDSA, *et al.*, 2018 (17)	9-25-year-old people with Down syndrome. Brazil	6 males and 10 females with Down syndrome.	Longitudinal study, qualitative, applied, field research.	Effects of electrostimulation on orofacial musculature and chewing, breathing, and swallowing functions in people with Down syndrome.
Hennequin M, *et al.*, 2005 (18)	17-43-year-old people with Down syndrome. France	6 males and 5 females with Down syndrome. 5 females and 7 males without the syndrome, ages 20-32 years.	Clinical, observational study.	Differences of chewing indicators between adults with and without Down syndrome, through video recordings.
Mazille MN, *et al.*, 2008 (19)	19-33-year-old people with Down syndrome. France	4 males and 4 females with Down syndrome, ages 19-33 years. 15 males without the syndrome, ages 21-24 years.	Randomized, double-blind, controlled (placebo) trial.	Impact on chewing pattern of an orthopedic devise to increase number of occlusal contacts in a group of young adults with Down syndrome.

The 11 selected studies were conducted in seven countries: Japan, Hashimoto, *et al.* (9); Singapore, Smith *et al.* (10); Spain, Zárate, *et al.* (11); France, Allison, *et al.* (12), Hennequin, *et al.* (18) Mazille, *et al.* (19), and Hennequin, *et al.* (13); UK, Thacker, *et al.* (14); US, Chenbhanich, *et al.* (15); and Brazil, Pinheiro, *et al.* (17), and Bermudez, *et al.* (16). We selected Studies with the following types of research designs: quasi-experimental, Hashimoto, *et al.* 2014 (9), and Hennequin, *et al.* (13); observational, Smith, *et al.* 2014 (10), Allison, *et al.* (12), and Hennequin, *et al.* (18); clinical evaluation, Zárate, 2001(11); questionnaire, Thacker, *et al.* (14); retrospective, Chenbhanich, *et al.* (15), and Bermúdez, *et al.* (16); longitudinal study, qualitative, applied, field research, Pinheiro, *et al.* (17); randomized controlled trial with placebo, Mazille, *et al.* (19). The Studies were published between 2001 and 2019. All the articles focused in clinical, anatomical, and functional characteristics during swallowing and chewing in people with Down syndrome.

DISCUSSION

Masticatory Function in Adults with Down Syndrome

Down syndrome is an autosomal chromosomal anomaly that induces selective hypotonia and poor neuromotor control, which can affect facial growth. The lips, masticatory muscles, larynx, and tongue muscles are hypotonic. The latter cause an abnormally large tongue appearance, which is favored by weakness and a low and anterior tongue position in the mouth. Usually, they present a scarce development of the middle third, with a mandible of normal development, for which a discrepancy in the intermaxillary relationship can be observed. Such a discrepancy affects the necessary occlusion for the stabilization of the mandible and the hyoid bone, in functions such as swallowing and chewing. They tend to compensate for the lack of interarch contacts by adopting a mandibular protrusive position to increase them, which is facilitated by the instability of the temporomandibular joint (that characterizes them, due to hyperlaxity of the ligaments of said joint) (13). It has also been possible to demonstrate a rudimentary sucking-swallowing feeding pattern and chewing with a rotating pattern, with depressed and ineffective food control. The lack of the mature pattern, moreover, causes chewing to occur for short periods (little or none). This aspect is also linked to the description of gastrointestinal problems aggravated by the lack of chewing.

Mazille *et al.* (19) proposed to assess the impact on chewing patterns of an orthotic device designed to increase the number of interarch contacts in a group of young adults with Down syndrome. They confirmed that chewing disturbances in adults with this syndrome are related to disorganized masticatory muscle activity. In addition, they noted that the use of an occlusal appliance increased chewing time, reduced chewing frequency, and increased the number of interarch occlusal contacts. However, they could not conclude whether the use of such a device improved chewing, recommending carrying out a study that would measure the comminution of the food bolus (19).

For this reason, in a study carried out in 2015, researchers evaluated the effect of the increase in the number of interocclusal contacts on the granulometry of the food bolus, using kinematic parameters of mastication and the frequency of food refusal in a group of young adults with Down syndrome. An improvement in food acceptance, chewing frequency, and bolus granulometry was evidenced after 8 weeks of using an appliance designed to increase occlusal contacts. Using the number of pairs of posterior contacts, the atomization of food during chewing was increased, additionally favoring sensory input, which improved motor coordination, due to the stimulation of periodontal and pulpal mechanoreceptors (13). Likewise, within the findings obtained in relation to chewing, Hennequin *et al.* (13) found out that by increasing the number of occlusal contacts through a plate, people with Down syndrome tended to reject less food. They felt subconsciously more confident in proper spraying, making food particles small enough, partly replacing the lack of occlusal contacts with a better distribution of interarch contacts, and thus stabilizing the mandible during swallowing. That allowed a better breathing-swallowing coordination, reducing the risk factor associated with aspiration of food. The authors concluded that it is essential to optimize interarch dental contacts when performing oral rehabilitation in people with Down syndrome and suggest that dental condition be analyzed when assessing feeding or swallowing behaviors (13).

In an investigation carried out by Allison *et al.* (12), different chewing indicators were analyzed in people with normal development and people with Down syndrome, through a video recording, in order not to alter the context or the behavior of the people with Down syndrome evaluated. The variables studied were chewing time (number of seconds between the time the food was placed in the mouth and swallowed), number of chewing cycles (number of closed chewing actions during chewing time) and number of open chewing cycles (chewing taken with the mouth open during the chewing time). When comparing the groups, it was possible to observe, on the one hand, that none of the participants rejected soft foods, but when increasing

the hardness of the foods, the percentage of adults with Down syndrome who rejected solid foods increased, in this case of carrot (59.1 %) and, on the other hand, that the chewing time was longer than in the control group for semi-solid consistency (sausage), but shorter for puree. It was also possible to observe in people with neurotypical development that there was a positive correlation between masticatory time and the number of cycles with the mouth closed, and that the number of rejections had no correlation with the hardness of the food. The authors concluded that both the chewing time, the number of closed and open chewing cycles, and moments of food refusal are valid variables to consider in people with Down syndrome, and the observations made through video recordings are useful to analyze these processes.

Subsequently, Hennequin *et al*. (18) assessed the differences in chewing indicators in a group of adults with Down syndrome and a control group of people without this condition, when eating different types of food. For this, they used video recordings, as previously proposed by Allison *et al.* (12). They found differences in masticatory function indicators between both groups, which could be observed in most of the ingested foods. Although the chewing frequency was lower in the group with Down syndrome, both the chewing time and the number of chewing cycles did not always show differences between the two groups. When considering open masticatory cycles, these were reported more frequently among people with Down syndrome. On the other hand, the rejection of certain foods was observed in the group with Down syndrome, but not in the control group. Another of the findings reported is that people with Down syndrome can demonstrate adaptive behavior in the face of functional disabilities, increasing or decreasing the number of chewing cycles depending on the type of food. In addition, since there was a rejection of foods with harder consistencies, it could be assumed that people with Down syndrome adjust their intake according to the texture of each food.

On the other hand, Hennequin *et al*. showed that people with Down syndrome developed at least three strategies when eating: Those foods that were difficult to chew were swallowed before forming a food bolus of appropriate granulometry. Others were chewed for a long time and/or with more cycles. Finally, food refusal was considered as a third strategy. A consequence possibly associated with masticatory dysfunction may be a nutritional deficiency, since a person with Down syndrome may lack the nutrients present in foods rejected for their texture or consistency (e.g., raw fruits and vegetables) and, at the same time, they prefer more tender foods, such as those rich in carbohydrates, which could promote obesity. Therefore, the authors concluded that people with Down syndrome demonstrated a systematic reduction in chewing frequency when eating different foods, highlighting the importance of educating parents and professionals about the chewing difficulties of this population (18).

Considering that the generalized muscular hypotonia present in people with Down syndrome favors masticatory disorders, Pinheiro *et al*. (17) carried out a study measure the effects of functional electrical stimulation (FES) on the orofacial musculature and on various functions, including chewing, in persons with Down syndrome. The results indicated that FES therapy favored lip closure, improved the appearance of the cheeks, favored the lateralization of the tongue to both the right and left sides, produced a favorable change in the respiratory mode, improved swallowing and, after the FES, the participants were able to make an unforced lip closure. It also reduced the tension of the facial muscles during swallowing. In relation to the masticatory function, cutting and crushing were aspects that improved significantly, showing that the cut was made by the incisors and the crushing presented an alternate bilateral pattern. The authors concluded that FES in conjunction with masticatory training significantly stimulated the orofacial musculature, improving chewing, breathing, and swallowing functions in people with Down syndrome.

Swallowing in Adults with Down Syndrome

One study evaluated tongue pressure generation in adults with Down syndrome as a measure of tongue function during swallowing. The measurement parameters (duration, maximum magnitude, and integrated value of tongue pressure) were different between participants with Down syndrome and a control group.

Hashimoto *et al*. (9) reported that the length and width of the palate in the participants with Down syndrome was significantly smaller than in the controls and is correlated with the lingual pressure obtained. Likewise, they suggested that a shorter palatal length favors the positioning of the tongue in the anterior sector of the maxilla, affecting the exertion of tongue pressure against the back middle part of the palate. In this way, by contacting the tip of the tongue with the lingual surface of the anterior upper teeth, an anterior seal of the oral cavity is produced, which compensates the underdeveloped maxilla with a decreased palatal length in people with Down syndrome. This study concluded that swallowing difficulties could be caused by the presence of a narrow and short palate, which would alter tongue control, activity, and movement in people with Down syndrome (9).

Smith *et al*. (10) evaluated oral feeding among adults with Down syndrome. Regarding eating and liquid drinking behaviors, they found difficulties in handling the utensils to transfer food and, on some occasions, it was observed that 30.4 % of individuals positioned the plate near their mouth and put their tongue on the edge of the plate, bringing it tongue closer with the spoon. 30.4 % of participants chewed the water and the spoon. 8.7 % added water and mixed it with the food before eating, while 21.7 % spit the food on the plate or on the table. Support and guidance can be beneficial for the normalization of feeding, when feeding; however, the support must be indirect since self-feeding must be promoted. It was further suggested that chewing liquids or chewing on an empty spoon might be associated with cognitive decline. In the oral phase, alterations were found in lip closure, tongue movements, and chewing and 17.4 % of people with Down syndrome, who swallowed multiple times for each bolus. Regarding the pharyngeal phase, the authors could only speculate on the issues observed, given the difficulty to exploring this phase by observation, which indicates alterations in this stage were detected more commonly in participants who ate a soft and wet diet. In addition, they reported 10 % of individuals reported changes in voice quality after feeding. On the other hand, they reported cough in more than 50 % of the participants, this being a possible sign of aspiration.

In the esophageal phase, an association between some esophageal motor disorders, particularly achalasia (a primary esophageal motor disorder whose etiology is unknown), and infectious, autoimmune, or genetic factors was found (11). Esophageal dysmotility (a motor disorder of the esophagus that affects the peristalsis of the esophageal body present in cases of Down syndrome) was also observed. The symptoms of dysmotility are not evident, but they include difficulty to swallowing, heartburn, regurgitation, and non-cardiac chest pain (11). Another study reported a prevalence of 5 % congenital gastrointestinal malformations, including esophageal atresia, and 7.2 % gastroesophageal reflux disease (GERD), whose symptoms include vomiting, regurgitation, aspiration pneumonia, and chronic cough (16).

Dysphagia is a significant problem in people with intellectual disabilities, as it can affect the health, safety, and general well-being of the person. A study that sought to know the most common causes of hospitalization in adults with Down syndrome found that 29.6 % was due to aspiration pneumonia, with the most common comorbidities (70.3 %) being GERD and dysphagia, requiring multiple admissions. Because of this, 16.2 % the patients required feeding via a gastrostomy tube, which was also associated with hospital readmissions (15).

Thacker *et al*. (14) conducted a study to investigate potential risk factors associated with history of choking among adults with intellectual disabilities, including those with Down syndrome. The latter were at higher risk of choking than adults with other disabilities. This may be because persons with Down syndrome have poor tongue coordination, favoring the uncontrolled entry of food into the pharynx that, when combined with a delay in triggering the swallowing reflex, increases the risk of aspiration (14).

Smith *et al*. (10) suggest that the anatomical differences and hypotonicity associated with Down syndrome, combined with sensory, cognitive, or behavioral disorders can cause difficulties in oral feeding, affecting health, safety, and social integration. Next, Tables 3 and 4 present the most relevant findings in chewing and swallowing functions, compared to the characteristics in neurotypical people.

TABLE 3
Comparative Chart of Masticatory Function

Characteristics of Masticatory Function in Neurotypical People	**Relevant Findings in Adults with Down Syndrome**
Intercuspation that stabilizes the mandible and hyoid bone (13)	Compensation for the lack of interarch contacts by adopting a protrusive position of the mandible (13,19)
Rotary mastication for hard foods or linguo-palatine apposition for soft foods.	*Chewing pattern is rudimentary, rotary, and open (12,13).*
Mastication occurs with a greater number of cycles in hard foods and less chewing time (12).	Mastication occurs with fewer cycles in hard foods and longer chewing time (12).
The correct one ensures the mechanical fragmentation of the food into particles, favoring digestion (13). People with good inter-cuspidation manage to have fewer food rejections because they are more efficient (13).	The lack of chewing produces gastrointestinal disturbances (13). The lack of interarch occlusal contacts makes bolus comminution difficult and increases the frequency of food refusal of hard foods (13).
Mandibular stabilization reduces the risk of food aspiration caused by poor breath-swallow coordination (13). Coordinated chewing and appropriate chewing force could optimize nutritional status, due to the consumption of a diet with different consistencies (18).	Mandibular instability is a risk factor for food aspiration caused by lack of breath-swallowing coordination (13). There are nutritional deficiencies associated with masticatory dysfunction, which could favor obesity (18).
	Functional electrostimulation improves parameters related to masticatory function, caused by hypotonia (17).

Source: the authors.

TABLE 4
Comparative Chart of Swallowing Function

Characteristics of Swallowing Function in Neurotypical People	**Relevant Findings in Adults with Down Syndrome**
The lingual pressure produced by the contact between the hard palate and the tongue is an important propulsive force for the transport of the food bolus towards the pharynx (9).	A reduced size of the palate affects the lingual pressure necessary for swallowing and encourages the tongue to adopt a forward posture (9).
There are no difficulty handling utensils (10).	Difficulties in handling utensils (10).
Neurotypical people do not chew liquids or empty spoons if they are not in a process of cognitive deterioration (10).	Chewing liquids or empty spoons may be associated with further cognitive decline (10).
Swallowing is favored by orofacial muscle tone (10).	There are alterations in lip closure in the oral phase (10).
The transition from the bolus is favored by muscle tone, making 1 or 2 swallows per bolus (10).	Some individuals have multiple swallows per bolus (10).
There is no voice change associated with aspiration of food (10).	Changes in voice quality after eating, associated with food aspiration (10).
Low prevalence of esophageal motor disorders in neurotypical population (11).	*Esophageal motor disorders associated with swallowing disorders, such as achalasia and esophageal dysmotility (11).*
Normal swallowing. It is not a factor that interferes with the social integration of people (10).	Oral feeding difficulties affect health, safety, and social integration (10,14).
Dysphagia is not reported as the most frequent cause of hospitalization in neurotypical people.	Dysphagia is the most common cause of hospitalization in adults with Down syndrome and is associated with aspiration pneumonia (15).

Source: the authors.

CONCLUSIONS

Adults with Down syndrome have anatomical and functional features that affect the chewing and swallowing processes.

Regarding the masticatory function, it has been observed that occlusion is important to carry out the chewing process satisfactorily. Likewise, people with Down syndrome tend to reject foods with harder consistency, which could be explained by the presence of alterations in oral motor learning associated with chewing and its phases. This constitutes a problem since the lack of stimulation obtained by eating hard foods favors hypotonia and hypofunction.

In relation to swallowing, it has been shown that intraoral anatomical and functional characteristics favor difficulties in swallowing performance, as well as alterations and challenges in the different phases of swallowing. Dysphagia is a relevant comorbidity in this population and one of the main causes of hospitalization.

Although there are publications that describe the clinical characteristics of adults with Down syndrome referring to swallowing and chewing functions, a few focus on the behaviors or habits generated throughout life. It results from beliefs, habits, and the social representation of the caregiver throughout the accompaniment of the person with Down syndrome.

This exploratory review highlights the need for all professionals involved in the rehabilitation of functional orofacial disorders described in adults with Down syndrome to work in an integrated manner, each contributing from their area of expertise and validating what other members of the health care team can contribute.

RECOMMENDATIONS

The first recommendation is to carry out in-depth studies to analyze the habits of caregivers and people with Down syndrome in adulthood to visualize the real challenges that they face daily, and thus plan and execute treatments that consider the resources families have in order to address the conditions that those in their care have.

Based on the articles reviewed in this study, it is proposed to incorporate video observation methodology to analyze the impact of orofacial functional treatments both in people with Down syndrome and those with other neuromotor disorders (12). In addition, the importance of maintaining special care for those who have a history of gastroesophageal reflux/dysphagia during their hospitalizations is highlighted (15). From this point of view, it is important to emphasize dental care when this antecedent exists.

Studies seeking to understand the tongue function during swallowing in people with Down syndrome are required, considering the measurement of tongue pressure can be a useful guide to assess the therapeutic effects of interventions designed to improve tongue function (19).

Likewise, the relevance of intervening the occlusal disorders observed in people with Down syndrome that favor orofacial functions of swallowing and chewing (13) is pointed out. It is important that specialists in orthodontics, temporomandibular disorders, and oral rehabilitation incorporate interdisciplinary health teams focused on the comprehensive rehabilitation of adults with Down syndrome.

On the other hand, considering that electrostimulation would be an effective tool for traditional therapy (17), further studies are recommended to increase the evidence of its applicability in the treatment of people with Down syndrome.

In addition, it is necessary to incorporate the concepts described in the International Classification of Functioning, Disability and Health to identify how oral feeding-related behaviors can influence the activities and social participation of adults with Down Syndrome (10).

Although Hennequin *et al.* (18) highlighted the need to continue investigating the orofacial functions of swallowing and chewing in people with Down syndrome, there is still a lack of studies allowing to clearly describe the difficulties that these patients face daily. Thus, it is recommended to develop projects aimed at addressing these shortcomings.

Acknowledgments

This review is part of the doctoral dissertation titled, "Feeding, swallowing, and chewing practices in people with Down syndrome: An analysis carried out from the parental perspective." It received approval by the Speech Therapy Research Laboratory, Ethics Committee for Research on Human Beings, School of Medicine, University of Chile, and the Ethics Committee of the University of the Argentine Social Museum.

References

1. Presson AP, Partyka G, Jensen KM, Devine OJ, Rasmussen SA, McCabe LL, McCabe ER. Current estimate of Down Syndrome population prevalence in the United States. J Pediatr. 2013 Oct; 163(4): 1163-1168. https://dx.doi.org/10.1016/j.jpeds.2013.06.013
2. Nazer H J, Cifuentes O L. Malformaciones congénitas en Chile y Latino América: una visión epidemiológica del ECLAMC del período 1995-2008. Rev Med Chile. 2011 Jan; 139(1): 72-78.
3. Glasson EJ, Dye DE, Bittles AH. The triple challenges associated with age-related comorbidities in Down syndrome. J Intellect Disabil Res. 2014 Apr; 58(4): 393-398. https://dx.doi.org/10.1111/jir.12026
4. Hawkins BA, Eklund SJ, James DR, Foose AK. Adaptive behavior and cognitive function of adults with down syndrome: modeling change with age. Ment Retard. 2003 Feb; 41(1): 7-28. https://dx.doi.org/10.1352/0047-6765(2003)041<0007:ABACFO>2.0.CO;2
5. Head E, Lott IT, Wilcock DM, Lemere CA. Aging in Down Syndrome and the Development of Alzheimer's Disease Neuropathology. Curr Alzheimer Res. 2016; 13(1): 18-29. https://dx.doi.org/10.2174/1567205012666151020114607
6. Lazenby T. The impact of aging on eating, drinking, and swallowing function in people with Down's syndrome. Dysphagia. 2008 Mar; 23(1): 88-97. https://dx.doi.org/10.1007/s00455-007-9096-1
7. Prasher VP, Metseagharun T, Haque S. Weight loss in adults with Down syndrome and with dementia in Alzheimer's disease. Res Dev Disabil. 2004 Jan-Feb;25(1): 1-7. https://dx.doi.org/10.1016/j.ridd.2003.04.005
8. Hennequin M, Faulks D, Veyrune JL, Bourdiol P. Significance of oral health in persons with Down syndrome: a literature review. Dev Med Child Neurol. 1999 Apr; 41(4): 275-283. https://dx.doi.org/10.1017/s0012162299000596
9. Hashimoto M, Igari K, Hanawa S, Ito A, Takahashi A, Ishida N, Koyama S, Ono T, Sasaki K. Tongue pressure during swallowing in adults with down syndrome and its relationship with palatal morphology. Dysphagia. 2014 Aug; 29(4): 509-518. https://dx.doi.org/10.1007/s00455-014-9538-5
10. Smith CH, Teo Y, Simpson S. An observational study of adults with Down syndrome eating independently. Dysphagia. 2014 Feb; 29(1): 52-60. https://dx.doi.org/10.1007/s00455-013-9479-4
11. Zárate N, Mearin F, Hidalgo A, Malagelada JR. Prospective evaluation of esophageal motor dysfunction in Down's syndrome. Am J Gastroenterol. 2001 Jun; 96(6): 1718-1724. https://dx.doi.org/10.1111/j.1572-0241.2001.03864.x
12. Allison PJ, Peyron MA, Faye M, Hennequin M. Video evaluation for mastication validation in persons with Down's syndrome. Dysphagia. 2004 Spring; 19(2): 95-99. https://dx.doi.org/10.1007/s00455-003-0506-8
13. Hennequin M, Mazille MN, Cousson PY, Nicolas E. Increasing the number of inter-arch contacts improves mastication in adults with Down syndrome: a prospective controlled trial. Physiol Behav. 2015 Jun 1; 145: 14-21. https://dx.doi.org/10.1016/j.physbeh.2015.03.034
14. Thacker A, Abdelnoor A, Anderson C, White S, Hollins S. Indicators of choking risk in adults with learning disabilities: a questionnaire survey and interview study. Disabil Rehabil. 2008; 30(15): 1131-1138. https://dx.doi.org/10.1080/09638280701461625
15. Chenbhanich J, Wu A, Phupitakphol T, Atsawarungruangkit A, Treadwell T. Hospitalisation of adults with Down syndrome: lesson from a 10-year experience from a community hospital. J Intellect Disabil Res. 2019 Mar; 63(3): 266-276. https://dx.doi.org/10.1111/jir.12572
16. Bermudez BEBV, de Oliveira CM, de Lima Cat MN, Magdalena NIR, Celli A. Gastrointestinal disorders in Down syndrome. Am J Med Genet A. 2019 Aug; 179(8): 1426-1431. https://dx.doi.org/10.1002/ajmg.a.61258
17. Pinheiro DLDSA, Alves GÂDS, Fausto FMM, Pessoa LSF, Silva LAD, Pereira SMF, Almeida LNA. Effects of electrostimulation associated with masticatory training in individuals with down syndrome. Codas. 2018; 30(3): e20170074. https://dx.doi.org/10.1590/2317-1782/20182017074
18. Hennequin M, Allison PJ, Faulks D, Orliaguet T, Feine J. Chewing indicators between adults with Down syndrome and controls. J Dent Res. 2005 Nov; 84(11): 1057-1061. https://dx.doi.org/10.1177/154405910508401117

19. Mazille MN, Woda A, Nicolas E, Peyron MA, Hennequin M. Effect of occlusal appliance wear on chewing in persons with Down syndrome. Physiol Behav. 2008 Mar 18; 93(4-5): 919-929. https://dx.doi.org/10.1016/j.physbeh.2007.12.010

Notes

* Original research.

How to cite this article: Sepúlveda Vega LE, Méndez P, Vázquez Fernández P. Description of Swallowing and Chewing Processes in Adults with Down Syndrome: An Exploratory Review. Univ Odontol. 2021; 40. https://doi.org/10.11144/Javeriana.uo40.dscp