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Chewing difficulties, oral health, and nutritional status in adults with intellectual disabilities: A cross-sectional study

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Abstract

Background: Chewing difficulty, poor oral health, inadequate and imbalanced nutrition are serious health problems in individuals with intellectual disabilities. The participants' chewing abilities, oral health and nutritional status were analysed in this study.

Methods: Forty-five adult participants with intellectual disabilities were included. Anthropometric measurements, oral health assessments, chewing ability evaluations and dietary intake analyses were conducted.

Results: A 56.8% of the participants were classified as overweight or obese. Teeth grinding was reported in 33.3% of the participants, while 40.0% experienced drooling. All participants with Down syndrome and 58.6% of the participants with developmental delay had chewing difficulties. Inadequate nutrient intake was observed and the fibre, vitamins B1, B3, B9, sodium, phosphorus and iron intakes were significantly lower than reference values in those with chewing difficulty ($p < .05$).

Conclusions: Chewing difficulties were associated with lower intake of certain nutrients, highlighting the importance of addressing oral health and dietary counselling in this population.

KEYWORDS
chewing ability, intellectual disability, malnutrition, nutritional status, oral health

1 | INTRODUCTION

Intellectual disability is a developmental disorder that affects an individual's intellectual functioning and adaptive behaviour, and emerges before the age of 18 (Schalock et al., 2010), and is classified according to the severity of the limitation of daily functioning (Conway et al., 2020). It is estimated that 1%–3% of the general population is affected by intellectual disability, which is caused by a variety of genetic and environmental factors (Skrzypek et al., 2021). Individuals with intellectual disability face significant challenges in many areas of life, including health and nutrition (Davis et al., 2014).

People with intellectual disability are more likely to have poor oral health (such as untreated caries and periodontal disease) than the general population (Morgan et al., 2012), which increases their risk of malnutrition, obesity and chronic oral diseases (Ziegler & Spivack, 2018).

Specific etiologies of intellectual disability lead to a more defined risk profile (Davis et al., 2014). Moreover, compared to the general population, people with intellectual disabilities have been reported to have poorer access to healthcare systems (Robertson et al., 2015), to be overrepresented in health inequalities (Cooper et al., 2015) and premature deaths (O'Leary et al., 2018).

Moreover, this population are more likely to have difficulties with eating and chewing (Rezaei et al., 2011; Robertson et al., 2018) and some of them may get assistance during mealtimes and the need increases over time (Ball et al., 2012). Chewing is a process that involves breaking down, crushing and mixing food, bolus formation and delivery to the pharynx, which greatly affects food intake (Krall et al., 1998). Chewing ability is related to the intake of nutrients and food groups. Having good chewing ability can help maintain and increase dietary diversity, which can help maintain individual's nutritional status and anthropometric values (Motokawa et al., 2021). Nutrition plays a critical role in optimising health (Tappenden et al., 2013), which makes it essential to understand and address the specific nutritional needs of individuals with intellectual disability. However, there is a lack of comprehensive research on the relationship between oral health and nutrition in individuals with intellectual disability. One study conducted by Batista and colleagues on individuals with intellectual disability between the ages of 5 and 53 who were semi-institutionalised revealed that the oral health and nutritional status of this group are closely related (Batista et al., 2009).

The purpose of this study is to address this research gap by analysing the participants' chewing abilities, oral health status and nutritional status to uncover potential associations in individuals with intellectual disability. Specifically, we examined the prevalence of chewing difficulties, as well as the impact of chewing difficulties and oral health variables on nutritional status and BMI in this population. By shedding light on the specific nutritional needs of individuals with intellectual disability, this study can inform the development of targeted intervention goals to improve health outcomes and reduce health inequalities in this population.

2 | METHODS

2.1 | Study design and participants

This cross-sectional study was conducted on 45 adult patients with intellectual disabilities, planned for treatment under general anaesthesia from May 2021 to May 2022. This study was conducted in alignment with the principles of the Declaration of Helsinki, and all procedures involving human participants were approved by the Marmara University ethics committee (Approval No: 29.04.2021/52). Written informed consent was obtained from the parents or guardians of all patients. The study took place at the Department of Oral and Maxillofacial Surgery, Marmara University, Faculty of Dentistry, a significant university hospital in Istanbul, Türkiye. The clinic where the study was conducted serves a wide range of oral and maxillofacial surgery cases and general dental conditions. While it provides comprehensive services in these areas, a significant aspect of its operations includes specialised care for patients with disabilities.

In this study, a convenience sampling approach was employed. All adult patients with intellectual disabilities seeking treatment under general anaesthesia at the Department of Oral and Maxillofacial Surgery, Marmara University, Faculty of Dentistry, during the study period (May 2021 to May 2022) were considered for inclusion. As patients presented to the clinic, they were sequentially invited to participate in the study, but those who did not accept to participate in the study ($n = 4$) and those with dysphagia ($n = 2$) were excluded from the study because dysphagia may also affect the chewing function of individuals.

2.2 | Data collection

Data were collected through clinical examinations of participants and a series of questionnaires via face-to-face interviews with caregivers. Sociodemographic information; including age, gender, type of disability, social and economic status (institutionalised or not, income level), education level of the caregiver (primary school, high school, university) and the presence of chronic diseases, was obtained from the caregivers. They also provided information about mealtime behaviours, which has an impact on food intake (e.g., problems during mealtimes, and assistance needed by the participants during mealtimes).

Subjective global assessment (SGA) was applied to determine nutritional status, chewing ability was questioned and dietary assessment was done by collecting 24-h food recall.

2.2.1 | Anthropometry and body composition

Anthropometric measurements, including height and weight were obtained for each participant according to standard procedures. Body mass index (BMI) was calculated by dividing body weight (kg) by the square of height in meters for the anthropometric evaluation of individuals with developmental delay, Down syndrome (DS), and autism spectrum disorder (ASD). The height of individuals with cerebral palsy (CP) was calculated by using the knee height according to the formulas below:

>18 years male: Height (cm) $= 64.16 - [0.04 \times$ age (year)] $+ [2.02 \times$ knee height (cm)].

>18 years female: Height (cm) $= 84.88 - [0.24 \times$ age (year)] $+ [1.83 \times$ knee height (cm)] (Width & Reinhard, 2020).

Anthropometric measurements were performed by a single examiner.

Body fat mass (kg), body fat percentage (%), fat-free mass (kg), muscle mass (kg), total body water (kg) and total body water percentage (%) of participants eligible for body analysis were measured by using TANITA DC-360 Body Analyser. These measurements could not be taken from the participants with cerebral palsy who have difficulties to stand still. The mid-upper arm circumferences (MUAC) of all participants were measured.

2.2.2 | Nutritional status

The nutritional status of participants was assessed by using the subjective global assessment (SGA), which is a valid and reliable scale (Detsky et al., 1987). SGA is widely used because it is easy to perform, non-invasive, inexpensive, can be performed in a short time and by any trained healthcare professional, and can identify patients at high nutritional risk (da Silva Fink et al., 2015). In the "medical history" part; patients were evaluated according to their change in body weight (<5%, 5%–10%, or >10% loss), change in food intake, gastrointestinal symptoms (anorexia, nausea, vomiting, diarrhoea), and functional capacity in the last 6 months. In the "physical examination" part, loss of triceps (triceps skinfold thickness) and subcutaneous fat tissue loss in the mid-axillary line on the lateral chest wall, loss of muscle mass and edema were evaluated. The authors of SGA do not attribute numeric scores to the tool and after scoring these two parts the patients are classified as: "well-nourished", "mild–moderate malnutrition", and "severe malnutrition" (Detsky et al., 1987).

2.2.3 | Oral health assessment

Clinical examinations of dental status were performed by a single examiner, in a dental chair with a dental mirror, an explorer and a WHO probe. All teeth were evaluated according to the criteria of the WHO using the decayed, missing and filled teeth (DMFT) and decayed, missing and filled surfaces (DMFS) indexes (Ainamo et al., 1982). The chewing performance of the dentition was determined by the number of opposing natural or prosthetic tooth pairs. The number of occluding posterior teeth was expressed in occlusal units (OUs). An occluding molar pair was counted as two occlusal units, whereas a premolar pair was counted as one occlusal unit. The number of occlusal unit per side was also determined since the distribution of occlusal units is known to influence chewing performance (Hatch et al., 2001; Käyser, 1981). Two opposing premolars were defined as one occlusal units and two opposing molars were defined as two occlusal units were investigated. Therefore, a person with a complete dentition had 12 total occlusal units (third molars/wisdom teeth excluded) (Käyser, 1981).

2.2.4 | Chewing ability

Chewing ability is evaluated through methods such as chewing tests, questionnaires or personal interviews. Chewing tests objectively measure masticatory efficiency, while questionnaires offer insights into an individual's subjective perception of their chewing ability. The increasing focus on patient-reported outcomes in recent years has made the patient-reported assessment approach particularly significant in evaluating chewing ability (Leake, 1990). Since it was not possible to receive feedback from the participants in our study, a proxy-reported approach was used where feedback was obtained from the caregivers who were primarily responsible for feeding of the participants. In this study, with open-ended questions; the foods that are difficult to chew for participants and the methods (boiling, cutting into small pieces, peeling etc.) applied by the caregivers for consumption of these foods were questioned. In addition, the chewing ability of the listed foods for the consumption of soft and hard foods was evaluated with closed-ended questions such as "Easy to chew", "Eat with some difficulty", "Eat with extreme difficulty/could not chew at all" (Akyıl et al., 2007). According to the International Dysphagia Diet Standardisation Initiative (IDDSI); soft foods (Level-6) are considered as tender, moist, and bite-sized, can be eaten with a fork, spoon, or chopsticks but do not need a knife to cut and must be chewed (e.g., boiled vegetables, rice, bread etc.) and hard foods (Level-7) are considered as normal, regularly eaten foods of various textures, any method may be used to eat and may be hard and crunchy (e.g., chocolate chips, almonds and hazelnuts, raw carrot etc.) (IDDSI, 2019). Individuals were evaluated as having "Difficulty in chewing" if at least two of them answered "Eat with some difficulty" or "Eat with extreme difficulty/could not chew at all" while chewing hard foods, and if at least four of them answered "Eat with some difficulty" or "Eat with extreme difficulty/could not chew at all" while chewing soft foods (Kossioni & Bellou, 2011).

2.2.5 | Dietary assessment

Food consumption records of participants were taken from the caregivers with a 24-h recall. The food consumption records obtained were analysed using the "Nutrition Information Systems Package Program (BEBIS) Version 7.0". The amount of ingredients included in the meals was calculated by using the "Standard Recipes" book, and the measurement amounts were calculated using the "Food Photo Catalog" book. The intake of energy, macronutrients and micronutrients of the participants was analysed and compared to the estimated average requirement (EAR) values for the Turkish population.

2.3 | Statistical analysis

The obtained data were evaluated statistically by using the SPSS 22.0 package program. Descriptive statistics in the evaluation of data; numbers and percentages for qualitative variables, mean, standard deviation, median, minimum and maximum for quantitative variables. Descriptive statistics were used to summarise participant characteristics, anthropometric measurements, oral health status and dietary intake. The conformity of the variables to the normal distribution was checked with the Kolmogorov–Smirnov test. Independent-samples t-test and One-Way ANOVA test were used for parameters conforming to normal distribution. Mann–Whitney U Test and Kruskal Wallis analysis method were applied for the parameters that did not comply with the normal distribution. The results were evaluated within the 95% confidence interval and the level of statistical significance was set at $p < .05$.

3 | RESULTS

3.1 | Participant characteristics

A total of 45 individuals with intellectual disability participated in the study, consisting of 53.3% males and 46.7% females. The majority of the participants (64.4%) had developmental delay, followed by 20.0% with autism spectrum disorder, 8.9% with Down syndrome and 6.7%

TABLE 1 General characteristics.

	n	%
Gender		
Male	24	53.3
Female	21	46.7
Type of disability		
Developmental delay	29	64.4
Cerebral palsy	3	6.7
Down syndrome	4	8.9
Autism spectrum disorder	9	20.0
Chronic illness		
No	28	62.2
Yes	17	37.8
Use of drugs and supplements		
No	17	37.8
Yes	28	62.2
Teeth-grinding		
No	30	66.7
Yes	15	33.3
Drooling		
No	27	60.0
Yes	18	40.0
	Mean ± SD	**Min–Max**
Age	32.8 ± 10.9	19.0–61.0
Tooth number ($n = 44$)	24.66 ± 6.20	12.0–32.0
DMFT ($n = 44$)	19.43 ± 7.99	4.0–36.0
DT ($n = 44$)	9.66 ± 6.10	0.0–27.0
MT ($n = 44$)	7.23 ± 6.32	0.0–28.0
FT ($n = 44$)	2.55 ± 3.70	0.0–16.0
DMFS ($n = 44$)	64.55 ± 34.3	12.0–164.0
OU ($n = 44$)	5.85 ± 3.49	0.0–12.0

Abbreviations: DMFS, decayed, missing and filled surfaces; DMFT, decayed, missing and filled teeth; DT, decayed teeth; FT, filled teeth; MT, missing teeth; OU, occlusal units.

with cerebral palsy. The prevalence of concomitant chronic diseases was 37.8%, with epilepsy and scoliosis being the most common.

Teeth-grinding was reported in 33.3% ($n = 15$) of participants. Additionally, 40.0% experienced drooling ($n = 18$). The study population had a mean number of 24.66 ± 6.20 teeth, a mean number of 9.66 ± 6.10 decayed teeth, 7.23 ± 6.32 missing teeth, 2.55 ± 3.70 filling teeth, 19.43 ± 7.99 DMFT, 64.55 ± 34.13 DMFS, and 5.85 ± 3.49 occlusal unit (see Table 1).

3.2 | Anthropometry and body composition

The anthropometry and body composition of participants varied according to the type of disability as shown in Table 2. The mean height of the participants was 158.3 ± 12.1 cm, with the Down syndrome group having the lowest mean height at 144.3 ± 4.9 cm. The mean body mass index of the developmental delay group was 25.2 ± 9.4 kg/m^2, while the DS group had a higher mean body mass index of 30.0 ± 3.6 kg/m^2. More than half of the participants (56.8%) were classified as overweight or obese. The highest mean muscle mass of all participants was 58.4 ± 18.8 kg which belonged to the autism spectrum disorder group.

According to subjective global assessment scores, there was no participant with malnutrition.

3.3 | Mealtime behaviours

Table 3 indicated that the participants consumed an average of 2.7 ± 0.4 main meals and 1.6 ± 1.1 snacks per day. The average time allocated for main meals was 22.8 ± 20.4 min, and for snacks, it was 9.0 ± 9.9 min. Water consumption among the participants was 1336.9 ± 795.7 mL. More than half of the participants (53.3%) received help during mealtimes, and 31.1% experienced problems during mealtimes, including choking, coughing and tingling sensations.

3.4 | Oral health and dietary intake

Decayed, missing and filled teeth (DMFT) and decayed, missing and filled surfaces (DMFS) scores according to chewing ability were given in Figure 1. The difference between these two scores according to the chewing ability of soft foods (Level-6 according to IDDSI) was not significant ($p > .05$). The DMFT score was found to be higher in those who had extreme chewing difficulty with hard foods (Level-7 according to IDDSI) (e.g., chocolate pieces, almonds, and hazelnuts) compared to those who chewed easily. For the apples with peels (Level-7), the DMFT score of those who had extreme difficulty in chewing was found to be higher than those who chewed with some difficulty and those who chewed easily ($p < .05$). The DMFS values were found to be higher in those who had difficulty in chewing almonds and hazelnuts, fried chicken, large pieces of meat, apples with peels, and raw carrots which are hard foods (Level-7) compared to those who could chew easily. For chocolate pieces (Level-7), it was found to be higher in both those who could chew with some difficulty and those who chewed with extreme difficulty compared to those who chewed easily.

There were negatively weak correlations between DMFT score and percentages of meeting EAR recommendation of vitamin D ($r = -.346$, $p = .025$), protein ($r = -.336$, $p = .029$), thiamine ($r = -.378$, $p = .014$), riboflavin ($r = -.342$, $p = .027$). There was a negatively moderate correlation between DMFS and the percentage of meeting EAR recommendation of vitamin D ($r = -.514$, $p = .001$), and negatively weak correlations with iron ($r = -.328$, $p = .034$), thiamine ($r = -.352$, $p = .022$), riboflavin ($r = -.418$, $p = .006$) (not shown in table).

TABLE 2 Anthropometry and body composition.

	Developmental delay			Down syndrome			Autism spectrum disorder			Total		
	n	Mean ± SD	Min-Max	*n*	Mean ± SD	Min-Max	*n*	Mean ± SD	Min-Max	*n*	Mean ± SD	Min-Max
Weight (kg)	26	63.7 ± 22.1	38.0–125.8	4	62.5 ± 8.6	50.2–69.5	8	83.3 ± 34.1	36.9–140.6	39	67.2 ± 24.8	36.9–140.6
Height (cm)	24	157.2 ± 10.9	139.0–178.0	4	144.3 ± 4.9	140.0–149.0	8	168.9 ± 10.5	155.0–184.0	37	158.3 ± 12.1	139.0–184.0
BMI (kg/m^2)	24	25.2 ± 9.4	13.9–49.1	4	30.0 ± 3.6	25.6–34.1	8	28.7 ± 10.5	15.4–45.2	37	26.3 ± 9.1	13.9–49.1
MUAC (cm)	27	27.0 ± 4.4	20.0–35.0	4	28.0 ± 3.0	25.0–32.0	7	29.0 ± 6.5	21.0–40.0	41	27.2 ± 4.7	19.5–40.0
Fat mass (kg)	11	22.9 ± 13.7	4.8–52.2	3	23.6 ± 7.5	17.5–31.9	5	23.3 ± 17.1	7.7–52.3	20	22.5 ± 13.1	4.8–52.3
Fat (%)	11	31.4 ± 9.6	8.7–41.5	3	35.3 ± 10.9	27.6–47.8	5	25.4 ± 8.7	13.9–37.2	20	30.2 ± 9.5	8.7–47.8
FFM (kg)	11	46.7 ± 15.9	29.4–73.6	3	43.0 ± 7.1	34.9–48.2	5	57.0 ± 27.4	15.4–88.3	20	48.1 ± 18.3	15.4–88.3
Muscle mass (kg)	11	44.4 ± 15.2	27.9–70.0	3	41.6 ± 7.7	33.1–48.2	5	58.4 ± 18.8	35.7–84.0	20	46.9 ± 16.0	27.9–84.0
TBW (kg)	11	35.9 ± 11.8	24.2–58.4	2	39.2 ± 1.9	37.8–40.6	5	45.2 ± 13.9	29.4–65.6	19	38.1 ± 12.1	24.2–65.6
TBW (%)	11	52.9 ± 7.3	46.4–70.6	2	58.9 ± 0.8	58.4–59.5	5	55.2 ± 6.1	46.7–63.8	19	54.3 ± 6.5	46.4–70.6
		n	%		*n*	%		*n*	%		*n*	%
BMI category (*n* = 37)												
Underweight		6	25.0		0	0.0		1	12.5		7	18.9
Normal		6	25.0		0	0.0		2	25.0		9	24.3
Overweight/obese		12	50.0		4	100.0		5	62.5		21	56.8
MUAC												
Normal		25	92.6		4	100.0		6	85.7		35	92.1
Nutritional risk		2	7.4		0	0.0		1	14.3		3	7.9

Abbreviations: BMI, body mass index; FFM, fat free mass; MUAC, mid-upper arm circumferences; TBW, total body water.

TABLE 3 Mealtime behaviours according to the types of disability.

	Developmental delay		Cerebral palsy		Down syndrome		Autism spectrum disorder		Total	
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max
Number of main meals ($n = 45$)	2.8 ± 0.4	2.0–3.0	2.6 ± 0.6	2.0–3.0	2.5 ± 0.6	2.0–3.0	2.8 ± 0.4	2.0–3.0	2.7 ± 0.4	2.0–3.0
Number of snacks ($n = 45$)	1.4 ± 1.0	0.0–3.0	1.7 ± 0.6	1.0–2.0	1.3 ± 1.3	0.0–3.0	2.7 ± 0.7	2.0–4.0	1.6 ± 1.1	0.0–4.0
Duration of main meals (min.) ($n = 45$)	20.7 ± 13.9	5.0–60.0	77.5 ± 60.1	35.0–120.0	28.8 ± 22.5	10.0–60.0	14.6 ± 7.9	5.0–30.0	22.8 ± 20.4	5.0–120.0
Duration of snacks (min.) ($n = 39$)	8.1 ± 5.9	1.0–30.0	36.0 ± 33.9	12.0–60.0	8.0 ± 6.1	4.0–15.0	6.0 ± 4.1	2.0–15.0	9.0 ± 9.9	1.0–60.0
Water consumption (mL) ($n = 42$)	1163.5 ± 741.3	0.0–3000.0	1083.3 ± 629.2	500.0–1750.0	1025.0 ± 206.2	800.0–1300.0	2061.1 ± 807.7	800.0–3000.0	1336.9 ± 795.7	0.0–3000.0
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Getting help during mealtimes										
No	11	37.9	0	0.0	3	75.0	7	77.8	21	46.7
Yes	18	62.1	3	100.0	1	25.0	2	22.2	24	53.3
Having problems during mealtimes										
No	20	69.0	0	0.0	2	50.0	9	100.0	31	68.9
Yes	9	31.0	3	100.0	2	50.0	0	0.0	14	31.1
Problems during mealtimes										
Choking	3	33.3	0	0.0	2	100.0	0	0.0	5	31.3
Coughing	3	33.3	1	33.3	0	0.0	0	0.0	4	25.0
Gagging	2	22.2	0	0.0	0	0.0	0	0.0	2	12.5
Inability to chew	2	22.2	0	0.0	0	0.0	0	0.0	2	12.5
Tingling	1	11.1	2	66.7	0	0.0	0	0.0	3	18.7
Chewing difficulty										
No	12	41.4	2	66.7	0	0.0	7	77.8	21	46.7
Yes	17	58.6	1	33.3	4	100.0	2	22.2	24	53.3

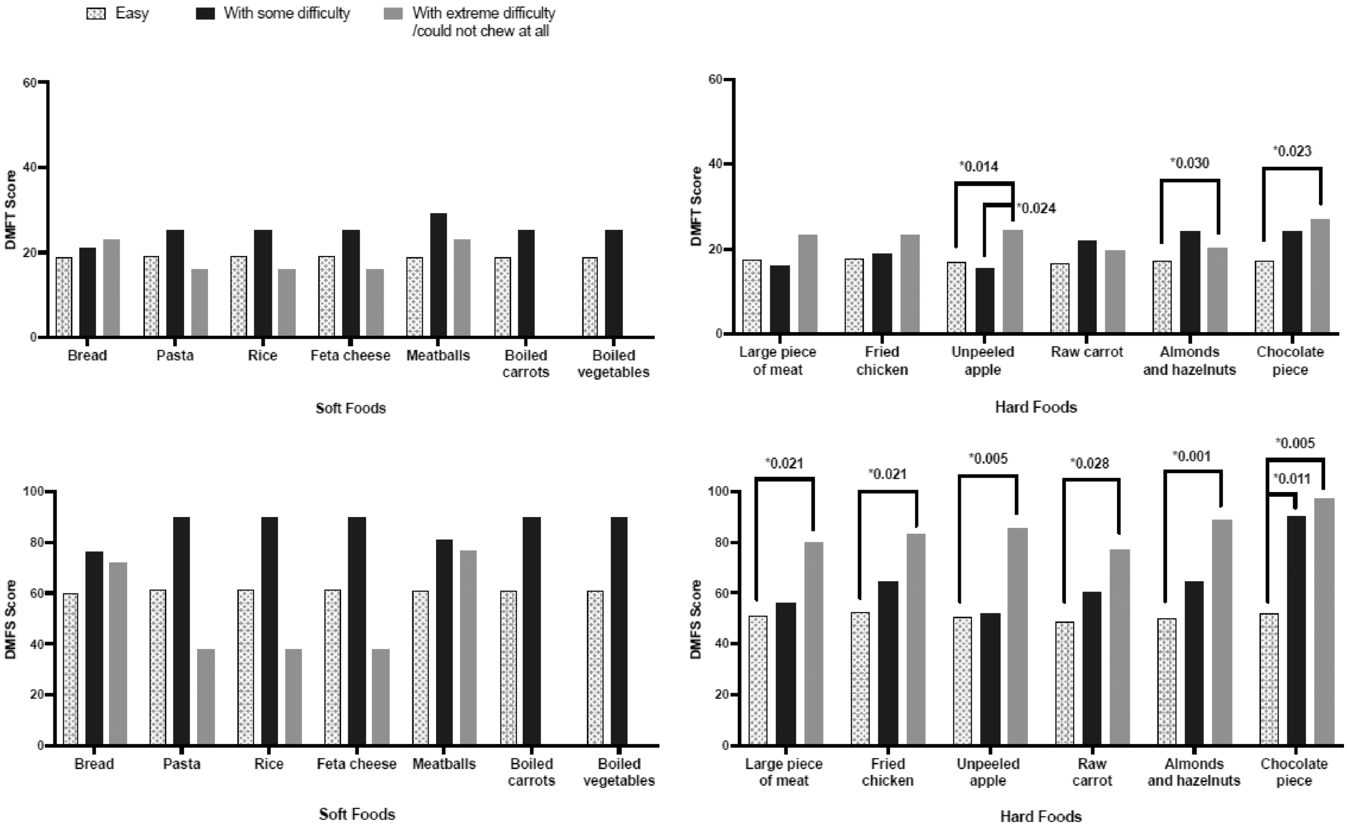

FIGURE 1 DMFT and DMFS scores according to chewability of soft and hard foods.

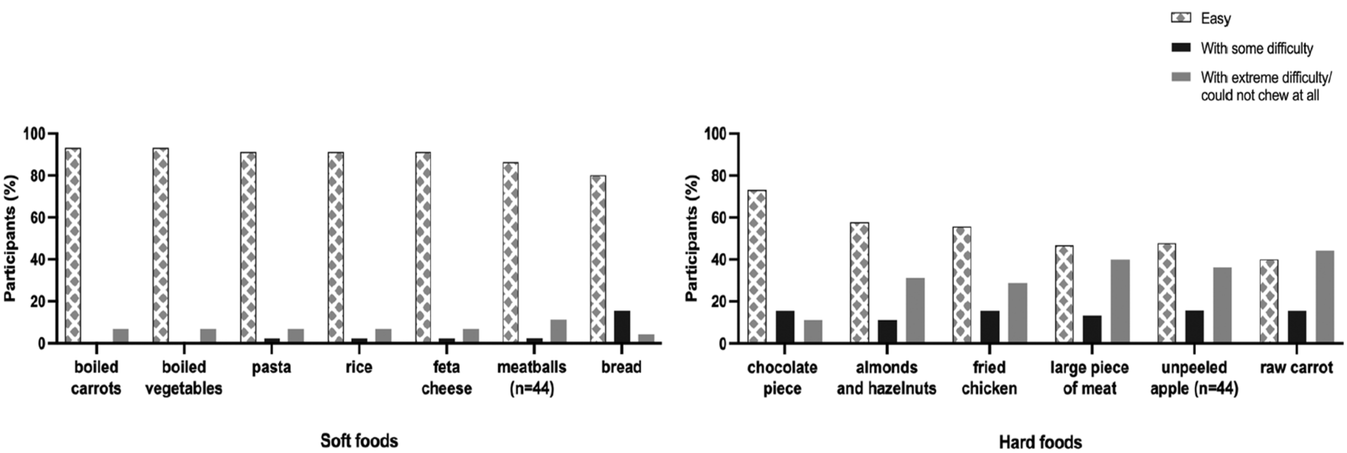

FIGURE 2 Chewing ability according to soft and hard foods.

3.5 | Chewing ability and dietary intake

The chewing abilities of the participants according to soft and hard food are shown in Figure 2. According to the statements of caregivers, 58.6% of the participants with developmental delay and all participants with Down syndrome had chewing difficulty. The majority of the participants (80.0%–93.3%) reported being able to chew soft foods easily. However, approximately half of the participants had difficulty chewing harder foods such as raw carrots, large pieces of meat, apples with peels, almonds, hazelnuts and fried chicken.

Significant differences in the occlusal unit and the number of teeth in occlusion between groups able to chew almonds and hazelnuts easily and those with difficulty were identified ($p = .005$ and $p = .009$, respectively) (not shown in table).

The percentage of energy and nutrient intakes of participants being below or above the estimated average requirement values was shown in Figure 3 and the percentage of meeting the energy, macro and micro-nutrients' references according to the chewing difficulty of participants was given in Table 4. Inadequate intakes of several nutrients were observed, with fluorine and potassium being the most

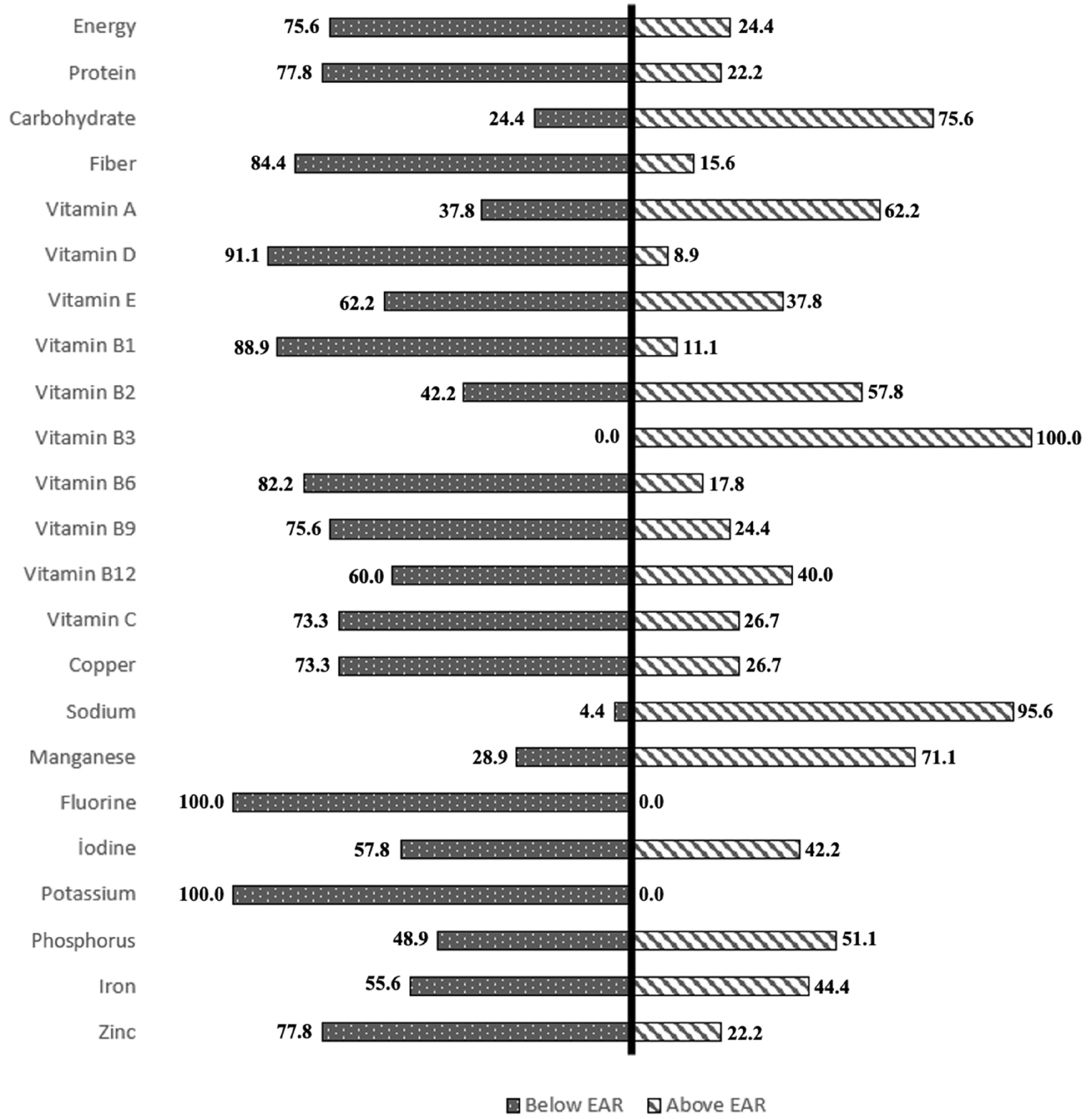

FIGURE 3 Energy and nutrient intakes of participants below or above the EAR (%).

deficient (100%), followed by vitamin D (91.1%), vitamin B1 (88.9%), fibre (84.4%), and vitamin B6 (82.2%).

4 | DISCUSSION

This study aimed to investigate the relationship between chewing abilities, mealtime behaviours, oral health and nutritional status of individuals with intellectual disability. Chewing ability plays a crucial role in shaping nutritional intake and dietary preferences, thereby exerting a substantial influence on general health. Effective chewing not only contributes to the health benefits derived from a variety of foods but also enhances the enjoyment and satisfaction experienced during meals (Joshipura, 1996). Our findings support the hypothesis that chewing difficulties and oral health parameters significantly impact the nutritional status of individuals with intellectual disability. The results revealed a strong association between chewing abilities and the intake of certain nutrients. Specifically, individuals who had chewing difficulty had a lower intake of fibre, vitamins B1, B3, B9, sodium, phosphorus and iron compared to those who did not have difficulty in chewing.

As individuals with intellectual disability age, the burden on their mothers appears to intensify (Lee & Chang, 2021). Many participants report that as children with intellectual disability enter adulthood, their behavioural patterns become more pronounced and less manageable. Furthermore, unresolved dental problems in children with intellectual disability are likely to worsen over time, leading to increased treatment needs such as emergency room visits and hospitalisation under general anaesthesia (Chi et al., 2014). Many studies reveal adults with intellectual disability experience poor and impaired

TABLE 4 Percentages of meeting EAR values according to chewing difficulty.

	Chewing difficulty		
	No ($n = 21$)	Yes ($n = 24$)	
	Mean ± SD	Mean ± SD	p
Energy	90.3 ± 29.8	85.5 ± 35.2	.623*
Protein	86.5 ± 29.2	77.6 ± 38.6	.390*
Carbohydrate	165.9 ± 65.9	146.4 ± 56.3	.288*
Fibre	82.7 ± 37.4	56.9 ± 25.7	.012*
Vitamin B1	74.2 ± 27.5	57.2 ± 25.6	.038*
Vitamin B2	112.6 ± 37.7	107.9 ± 49.0	.729*
Vitamin B9	92.5 ± 32.6	72.8 ± 26.7	.031*
Sodium	244.5 ± 96.8	181.3 ± 87.5	.026*
Manganese	151.9 ± 65.1	135.2 ± 86.8	.473*
Fluorine	22.8 ± 8.9	22.5 ± 14.9	.929*
Iodine	111.0 ± 46.1	94.8 ± 67.3	.359*
Calcium	75.8 ± 31.4	73.9 ± 46.1	.876*
	Median (min-max)	Median (min-max)	p
Vitamin A	106.2 (51.6–408.4)	113.4 (29.4–681.7)	.927+
Vitamin D	20.7 (5.9–173.7)	15.4 (4.4–105.5)	.158+
Vitamin E	84.9 (24.1–281.6)	83.5 (13.0–333.1)	.674+
Vitamin B3	345.2 (172.8–649.6)	214.9 (125.5–854.6)	.034+
Vitamin B6	74.6 (44.6–186.2)	65.8 (32.3–269.2)	.339+
Vitamin B12	92.3 (17.5–190.5)	84.5 (15.5–554.5)	.387+
Vitamin C	70.2 (4.9–373.6)	41.9 (4.5–187.6)	.145+
Copper	88.1 (39.4–196.2)	77.8 (33.9–179.2)	.509+
Potassium	44.0 (25.1–97.5)	34.7 (14.0–85.1)	.111+
Phosphorus	80.4 (38.5–282.9)	131.5 (15.2–295.2)	.045+
Iron	197.8 (32.2–317.3)	55.7 (14.0–442.9)	.001+
Zinc	70.2 (41.2–184.0)	65.4 (35.4–191.2)	.125+

*Independent sample *t*-test.
+Mann–Whitney U test.

oral health (missing teeth, periodontal health and untreated dental caries, etc.). Functional loss of tooth structure can cause difficulty in chewing, swallowing, feeding, speaking, pain and serious systemic health problems (Anders & Davis, 2010; Wilson et al., 2019). In addition, difficulty eating is generally recognised to increase in frequency in older age. As individuals with intellectual disability age, edentulism is experienced to a greater extent and at an earlier age, than the general population (Mac Giolla Phadraig et al., 2019).

A significant proportion of adults with intellectual disability experience eating/feeding difficulties, with studies indicating prevalence ranging from 8.1% to over 50% (Manduchi et al., 2020). Those with more severe intellectual disability and physical impairments appear to be particularly affected (Huang & May, 1996; Matson et al., 2008). Studies have identified many poor oral health outcomes, including difficulty in chewing, that cause poor nutritional consequences for individuals with intellectual disability (Hennequin et al., 2005; Traci et al., 2002). The chewing process is considered to affect the timing of food transport and swallow initiation (Saitoh et al., 2007). Taken together, they are often considered to represent the feeding process (Thexton, 1992) which has an enormous effect on energy intake and weight status (Faith et al., 2004). For instance, in a study, it was determined that problems such as chewing and swallowing difficulty experienced by individuals with cerebral palsy resulted in low body mass index, inadequate and imbalanced nutrition and it was emphasised that they were at risk in this respect (Sanders et al., 1990). While the oral hygiene and periodontal conditions of individuals with intellectual disability were found to be worse than the individuals without intellectual disability, it is also stated that the risk of having dental caries had increased (El Khatib et al., 2014; Jaber, 2011). Some studies have shown that individuals with intellectual disability have fewer caries and fillings in their permanent teeth (Fakroon et al., 2015; Gržić et al., 2011; Morgan et al., 2012; Ozgul et al., 2014; Schulte et al., 2013; Shukla et al., 2014); whereas some other studies have revealed that individuals with intellectual disability have higher DMFT scores and fewer filled permanent teeth, more permanent missing teeth because of caries than individuals without intellectual disability (Batista et al., 2009; Pregliasco et al., 2001). In a study with 102 institutionalised and noninstitutionalized adults with developmental disabilities, it was found that the study group had a higher prevalence of dental caries, poor oral hygiene and higher DMFT scores (Seirawan et al., 2008). In our study, the mean DMFT and DMFS scores of the participants was found to be higher than some dental surveillances and the mentioned previous study (Beltrán-Aguilar et al., 2005). Being an institutionalised person may make a positive difference as having periodical check-ups including dental examinations and strict dietary control. In our study, there was no institutionalised person so this possibly resulted in having higher DMFT scores. High DMFT and DMFS scores due to the high number of decayed and missing teeth suggest that it may cause difficulty in chewing function. It is known that occlusal strength decreases with increasing tooth loss (Van der Bilt et al., 1993). This decrease in occlusal function causes deterioration in chewing ability and problems in food selection, worsening the nutritional status of individuals compared to the general population (Joshipura et al., 1996). In our study, the mean occlusal unit of the participants was 5.85 ± 3.49 and the mean missing teeth number was 7.23 ± 6.32. Possibly related to these outcomes, chewing difficulties were common among the participants, particularly in those with developmental delay and Down syndrome. Additionally, we found significant associations between impaired chewing abilities and a lower intake of fibre, vitamins B1, B3, B9, sodium, phosphorus and iron indicating the potential impact of chewing difficulties on nutrient intake. Therefore, addressing oral health issues and providing appropriate mealtime support may be crucial in improving the nutritional outcomes of individuals with intellectual disability.

The literature highlights that being obese or overweight is more common among individuals with intellectual disability, and therefore an accurate measurement of body composition is very important (Yamaki, 2005). In a study conducted with 33 adults with intellectual disability, the mean body mass index of all participants was found as 27.5 ± 6 kg/m^2 (men: 25.6 ± 4 kg/m^2; women: 28.9 ± 7 kg/m^2) (Hamzaid et al., 2019). In another study, adults with intellectual disability were 1.3 times more likely to be obese compared to adults without intellectual disability (Havercamp & Scott, 2015). In a study of adults with intellectual disability, Koritsas and Iocona found that 37.5% of the participants had normal body mass index and 41% had obesity. In the same study, 42.6% of the participants fell in the minimum risk category, 38.2% in the moderate risk category and 17.6% in the high-risk category for malnutrition (Koritsas & Iacono, 2016). In the study of Batista and colleagues, 60% of the adults had suboptimal nutritional status and (7% underweight, 53% overweight or obese) (Batista et al., 2009). In our study, there was no participant with malnutrition or at high risk of malnutrition according to the subjective global assessment scores. In the study of Hoey and colleagues, the mean body mass index of male participants was 28.8 ± 5.8 kg/m^2 and the mean body mass index of female participants was 30.2 ± 6.5 kg/m^2. Of all, 28.2% of the participants were overweight and 46.8% were obese which made 75% of the participants above normal body mass index. Moreover, having a diagnosis of Down syndrome was significantly associated with increased body mass index (Hoey et al., 2017). In accordance with these findings, the mean body mass index of all participants in our study was found as 26.3 ± 9.1 kg/m^2 and the mean body mass index of adults with DS was 30.0 ± 3.6 kg/m^2. This could be a result of the characteristic of being typically shorter in this population. The high prevalence of overweight and obesity among our participants is consistent with previous research on individuals with intellectual disability (Batista et al., 2009; De et al., 2008; Hsieh et al., 2014). Variations in anthropometric measurements across different types of disabilities might be attributed to differences in genetics, muscle tone, physical activity levels and medication use.

A high prevalence of inadequate nutrient intake (ranging from 46% to 90%) among individuals with intellectual disability has been indicated (Dahl et al., 1996). The results of our study and the literature suggest that individuals with intellectual disabilities are at a higher risk of poor nutritional status (Hasegawa et al., 2020). Furthermore, we found that a substantial proportion of participants had a low intake of key nutrients such as calcium, magnesium and iron, with fibre intake being particularly low. These results emphasise the importance of providing appropriate mealtime support, nutritional counselling and addressing oral health issues to improve the nutritional status of individuals with intellectual disability. Overall, our findings contribute to the growing body of evidence that underscores the need for comprehensive interventions aimed at improving the nutritional status of individuals with intellectual disability.

4.1 | Limitations

This study has some limitations, including its cross-sectional design and small sample size of various groups with different disabilities, which may limit the generalizability of the findings. Moreover, the use of convenience sampling, while practical for this study, might also affect the representativeness of the sample and consequently, the applicability of the results to a broader population. Additionally, the proxy-reported data might introduce recall bias and over- or under-reporting. Future research should employ longitudinal designs and larger, more diverse samples to further investigate the relationship between chewing abilities, mealtime behaviours, oral health and nutrient intake in individuals with intellectual disabilities.

5 | CONCLUSION

There are very few studies in the literature that relate oral health and the nutritional status of adults with intellectual disabilities. We think that our study will contribute to the literature in terms of evaluating both the effect of oral health on chewing ability and the effect of chewing ability on food intake in adults with intellectual disabilities, which is the major strength of our study.

It is demonstrated that chewing difficulties and poor oral health status are prevalent among individuals with intellectual disabilities and are significantly associated with lower nutrient intake and higher body mass index. These findings underline the importance of addressing oral health and chewing abilities in individuals with intellectual disabilities to improve their nutritional status and overall health. Although there was no participant with malnutrition in our study, the results may be more dramatic considering the general population with intellectual disability in terms of nutritional problems and inadequate nutrient intake. Further research is needed to explore additional factors contributing to nutritional challenges faced by this population and to develop targeted interventions for addressing these challenges.

AUTHOR CONTRIBUTIONS

Ayşe Hümeyra İslamoğlu: Conceptualization, Formal analysis, Methodology, Supervision, Visualisation, Writing original draft, Review & editing. **Gülcan Berkel:** Conceptualization, Visualisation, Review & editing. **Hatice Selin Yildirim:** Formal analysis, Writing original draft, Review & editing. **Şule Aktaç:** Conceptualization, Methodology, Supervision, Visualisation, Writing original draft. **Ferit Bayram:** Formal analysis, Visualisation, Writing original draft. **Güleren Sabuncular:** Formal analysis, Visualisation, Writing original draft. **Fatma Esra Güneş:** Conceptualization, Methodology, Review & editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest regarding the research, authorship and publication of this article.

DATA AVAILABILITY STATEMENT

De-identified and aggregated data from the current study are available from the corresponding author upon reasonable request and in accordance with the ethical approval granted for this study.

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