ORIGINAL ARTICLE

Turkish Version of the Mastication Observation and Evaluation (MOE) Instrument: A Reliability and Validity Study in Children

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Abstract

The Mastication Observation and Evaluation (MOE) instrument is an objective assessment of the chewing process in children. This study aimed to translate the MOE into Turkish and to test its reliability and validity in children with cerebral palsy (CP). A total of 53 children with CP and 27 typical children were included in the study. The MOE was translated from Dutch into Turkish by using the forward, backward, forward translation method. The internal consistency, intra- and inter-observer reliability, criterion, and discriminant validity of the Turkish version of the MOE (T-MOE) were investigated. Internal consistency was excellent with a Cronbach's alpha value of 0.98. The Intraclass correlation coefficient ranged from 0.89 to 0.97 for intra-rater reliability and from 0.86 to 0.94 for inter-rater reliability. The median score from Karaduman Chewing Performance Scale (KCPS) was 7 (min = 1, max = 8). All of the items in the T-MOE and the total T-MOE score had a negative and strong correlation with the KCPS score. Typical children without chewing disorders had greater T-MOE scores than the children with CP suffering from chewing disorders ($p < 0.01$). The T-MOE is a reliable and valid instrument for evaluating the observed oral motor behaviors of chewing function in children. It can be used in clinical practice and research.
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Keywords Deglutition · Deglutition disorders · Chewing · Chewing disorder · Children · Assessment

Introduction

Chewing function is a complex and rhythmic process that begins with accepting food in the mouth, continues with placing the food between the molar teeth, crushing the food into smaller pieces and concludes with swallowing [1]. Children start to develop the necessary coordinated chewing movements by 9 months [2] and can manage solid foods at 12 months [3]. A 4-year-old child is expected to manage a normal diet that includes all food textures [4]. Not all children develop the chewing process properly and in a timely manner. While some children with typical development may encounter problems in chewing function for several reasons, including lack of experience, environmental factors, family factors, etc., children with neurological disorders may also struggle with chewing impairments [5]. Chewing disorders result in several conditions including food refusal, throwing food out of the mouth, food leakage, gagging or choking during swallowing, and residue after swallowing [6]. Therefore, early evaluation and detecting the reason for chewing difficulties is important.

Various methods have been reported to evaluate chewing function, including sieving methods, color changes in chewing gum, the colorimetric method, and electromyographic evaluation [7–10]. These methods are used primarily in adult populations. Evaluation of chewing function in children is more difficult. It is usually observational and based on clinical judgment. The current literature regarding chewing evaluation in children reports two instruments basically focused on chewing function; The Mastication Observation and Evaluation (MOE) [11, 12] and Karaduman Chewing Performance Scale (KCPS) [13]. These two instruments have some features in common, including the fact that they are practical and easy to use, they provide a guide for training, and fill a significant gap in chewing evaluation in children.

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Despite these similarities, they are different from each other due to their structural characteristics. The MOE assesses the individual chewing skills required for efficiently consuming solid foods, while the KCPS is used to determine a child's chewing performance level. Therefore, these two instruments can be used to complement each other. The KCPS was developed in the Turkish language, and there is a need for an instrument like MOE in the Turkish language to provide a holistic approach to chewing evaluation in children. Thus, the purpose of this study was to translate the MOE into Turkish and investigate the internal consistency, intra- and inter-observer reliability, and the criterion validity of the Turkish version of the MOE (T-MOE). As part of the analysis of the validity, a comparison between children with and without chewing disorders was used to assess discriminant validity of the T-MOE.

Materials and Methods

The study was performed at the Faculty of Physical Therapy and Rehabilitation at Hacettepe University with the cooperation of Hacettepe University Swallowing Disorders Research and Application Center. The Non-invasive Clinical Research Ethics Committee approved the study protocol. There were two groups in this study. Group I included children with cerebral palsy (CP) who were between 2 and 11 years old. They all had classifications II to IV on the Gross Motor Function Classification Scale (GMFCS) [14], and all complained about chewing function and could not manage solid food intake. Children in Group I were recruited from the Swallowing Disorders Unit in Faculty of Physical Therapy and Rehabilitation. Group II (control group) included typical children who could manage solid food intake and had no complaints about chewing function. Children in group II were recruited from childcare centers in Ankara. Children who were below the age of 18 months and used any medicine and/or oral appliances that could affect chewing function were excluded from the study. Written informed consent in accordance with the Declaration of Helsinki was obtained from the parents and all data were collected prospectively.

The study consisted of 3 parts that were translation of the MOE into Turkish, the internal consistency and reliability parts and the validation part. Authorization and permission was obtained for validation from Remijn, the copyright owner [11].

Translation of the MOE into Turkish Language

The guideline proposed by Beaton et al. was used for translation of the MOE [15]. First, two bilingual Turkish individuals translated the MOE from Dutch into Turkish. Two translations were examined and converted into a single scale with

a consensus (synthesis). A native Dutch-speaking language expert outside of the medical profession who also speaks Turkish translated the instrument from Turkish into Dutch (backward translation). The original and backward versions were compared in a meeting held by a methodologist, a language professional and the entire translation team, and the final Turkish version was completed (expert committee review). The backward translation was presented to the creator of the scale and the translation process was completed.

Internal Consistency, Intra-observer and Inter-observer Reliability

As reliability measures, the internal consistency, intra-observer reliability and inter-observer reliability were tested. Internal consistency is the coherence of results across items within an instrument [16]. Intra-observer reliability is the stability of an individual's observation of a situation at two or more time intervals, and inter-observer reliability refers the degree to which the result of a test is consistent over time [16]. A physical therapist with 10 years of experience in the field of deglutition disorders analyzed all chewing videos and scored each video according to the T-MOE. To determine intra-observer reliability, the physical therapist rescored the videos after an interval of 1 week. Another physical therapist with 19 years of experience independently analyzed each video according to the T-MOE, and the correlation between T-MOE scores of these two physical therapists was calculated to test inter-observer reliability.

Criterion and Discriminant Validity

As validity measures, criterion and discriminant validity were tested. Criterion validity refers if the instrument is measuring the correct outcome [16]. The criterion validity of the T-MOE was determined by calculation of the correlation between T-MOE and the KCPS. Discriminant validity refers if a measured variable that are not supposed to be related is actually related [16]. The comparison between children with chewing disorders (Group I) and without chewing disorders (Group II) was used to assess discriminant validity of the T-MOE.

Chewing function was evaluated by observing a child during chewing a standardized biscuit. Chewing videos was recorded using a camera (Sony HDR-PJ410 Handycam Camera, Sony Europe Limited, Weybridge, Surrey, UK) for 3–5 min. A standardized biscuit was presented to each child to bite and chew while in a sitting position in a quiet environment. Each chewing video was scored according to the T-MOE and KCPS. The MOE was scored 8 items on a 4-point ordinal scale. The items included movement of the lips, tongue, jaw, and chewing duration; loss of food or saliva; the number of swallows; and

swallowing coordination [11, 12]. The lower scores on the 4-point scale reflect 'very inappropriate,' while higher scores reflect 'very appropriate' movements and behaviors. The KCPS is a five level ordinal scale to be used to determine the chewing performance level in children. Level 0 indicates 'Normal chewing function', and level 4 indicates 'No biting and chewing' [13].

Statistical Analysis

The IBM-SPSS for Windows version 20 (IBM Corp., Armonk, NY, USA) was used to perform statistical analysis. Descriptive statistics were calculated as a number/percent (n/%) for qualitative data and mean ± standard deviation for quantitative data. The internal consistency was measured by using Cronbach's alpha. An alpha value between 0.70 and 0.80 indicates acceptable, between 0.8 and 0.9 indicates good, and greater than 0.9 indicates excellent consistency [17]. The Intraclass Correlation Coefficient (ICC) value with 95% confidence intervals was used to estimate intra- and inter-observer reliability. An ICC range between 0.60 and 0.80 represents good and an ICC greater than 0.80 represents excellent correlation. The Spearman's correlation coefficient was used to assess the correlation between the T-MOE and KCPS to determine criterion validity. A Spearman's correlation coefficient (r) less than 0.30 indicates weak, between 0.30 and 0.70 indicates moderate, and greater than 0.70 indicates strong correlation [18]. The Mann–Whitney U test was used to compare T-MOE between children with and without chewing disorders to determine discriminant validity.

Results

Translation of the MOE into Turkish Language

The translation of the MOE from Dutch into Turkish language did not have any linguistic problem. The final version was presented to the creator of the scale and every item of the T-MOE was identical to the original version. The list of the T-MOE is represented in the Appendix 1 (Supplementary material).

Internal Consistency, Intra-observer and Inter-observer Reliability

A total of 53 children with CP who had complaints about chewing function and a total of 27 typical children who had no complaints about chewing function were included to assess the reliability and validity of the T-MOE. The descriptive characteristics of the children are shown in Table 1.

The median T-MOE scores for each item and total score from the T-MOE are reported in Table 2. Internal consistency of the T-MOE was excellent with a Cronbach's alpha value of 0.98. The ICC scores of the T-MOE for intra-rater reliability are shown in Table 2. A strong positive correlation was found between two analyses by the one physical therapist, which indicates intra-observer reliability ($r = 0.79$–0.95, $p < 0.001$). The ICC scores of the T-MOE for inter-rater reliability ranged between 0.86 and 0.94. A strong positive correlation was found between the T-MOE scoring of two physical therapists, indicating inter-observer reliability ($r = 0.86$–0.89, $p < 0.001$).

Table 1 The descriptive characteristics of the children

	Group I $n = 53$ Mean (SD)	Group II $n = 27$ Mean (SD)	p
Age (year)	4.07 (2.39)	4.22 (0.75)	0.21
Height (cm)	91.40 (15.54)	101.50 (7.77)	0.002*
Weight (kg)	13.41 (5.07)	16.50 (3.69)	0.001*
Transition time to additional food (month)	6.79 (2.97)	6.14 (0.36)	0.75
Meal time (min)	35.05 (33.17)	16.85 (2.46)	0.002*
Number of meals in a day	4.82 (2.46)	3.59 (0.69)	<0.001
Initial teething time (month)	8.34 (3.25)	6.44 (0.57)	0.02*
Oral motor evaluation parameters	N (%)	N (%)	
Open mouth	27 (50.9)	0 (0)	<0.001
Open bite	19 (35.8)	0 (0)	<0.001
Tongue thrust	26 (49.1)	0 (0)	<0.001
High palate	30 (56.6)	0 (0)	<0.001

*$p < 0.05$

Table 2 The median scores and intra-observer reliability of the Turkish mastication observation and evaluation

Turkish mastication observation and evaluation	Median	Min–max	ICC
Item 1: tongue protrusion	4	1–4	0.90
Item 2: lateral tongue movement	3	1–4	0.95
Item 3: squashing or sucking tongue movement	4	1–4	0.95
Item 4: jaw movement	3	1–4	0.96
Item 5: chewing duration	3	1–4	0.97
Item 6: food loss or saliva	3	1–4	0.89
Item 7: number of swallows	2	1–4	0.93
Item 8: fluency/coordination	3	1–4	0.96
Total score	24	8–32	0.96

ICC intraclass correlation coefficient

Table 3 The correlation between the Turkish mastication observation and evaluation and the Karaduman Chewing Performance Scale

MOE	Karaduman Chewing Performance Scale	
	r	*p*
Item 1: tongue protrusion	− 0.76	< 0.001
Item 2: lateral tongue movement	− 0.88	< 0.001
Item 3: squashing or sucking tongue movement	− 0.86	< 0.001
Item 4: jaw movement	− 0.89	< 0.001
Item 5: chewing duration	− 0.87	< 0.001
Item 6: food loss or saliva	− 0.85	< 0.001
Item 7: number of swallows	− 0.86	< 0.001
Item 8: fluency/coordination	− 0.87	< 0.001
Total score	− 0.91	< 0.001

Criterion and Discriminant Validity

The median KCPS score was 7 (min = 1, max = 8). A negative and strong correlation was found between all items of the T-MOE as well as the total score and the KCPS scores. The correlation coefficients between each item of the T-MOE and KCPS are presented in Table 3.

Typical children without chewing disorders had greater scores in the T-MOE compared with children with CP suffering from chewing disorders ($p < 0.001$) (Table 4).

Discussion

The current study aimed to translate the MOE into Turkish, and investigated the internal consistency, intra- and inter-observer reliability, criterion and discriminant validity of the T-MOE. The results showed that the T-MOE had acceptable psychometric properties. The reliability of the T-MOE is excellent in terms of internal consistency and intra- and inter-observer reliability, and the instrument has sufficient validity.

Early attention should be given to chewing evaluation and chewing training in children due to its consequences on children and their families [6, 19, 20]. Chewing evaluation is difficult due to its observational characteristic in children. The MOE is a criterion-referenced instrument that is used to evaluate the individual chewing skills that are required for efficient intake of solid foods. It has also been reported that it provides advice how to intervene to improve chewing function and solid food intake [12]. The instrument was developed in the Dutch language in 2013 [11], and no previous study has investigated the translation of the instrument into other languages despite the need for such an instrument as the MOE in the clinical settings worldwide. In Turkey, there is a need for an instrument like MOE to provide a holistic approach to evaluate chewing function in children. Therefore, the present study is the first to translate the MOE

Table 4 The Turkish mastication observation and evaluation scores of children with and without chewing disorders

Turkish mastication observation and evaluation	Group I n = 53 Median (min–max)	Group II n = 27 Median (min–max)	p
Item 1: tongue protrusion	1 (1–4)	4 (4–4)	< 0.001
Item 2: lateral tongue movement	1 (1–4)	4 (3–4)	< 0.001
Item 3: squashing or sucking tongue movement	1 (1–4)	4 (4–4)	< 0.001
Item 4: jaw movement	1 (1–4)	4 (3–4)	< 0.001
Item 5: chewing duration	1 (1–4)	4 (3–4)	< 0.001
Item 6: food loss or saliva	2 (1–4)	4 (2–4)	< 0.001
Item 7: number of swallows	2 (1–4)	4 (2–4)	< 0.001
Item 8: fluency/coordination	1 (1–4)	4 (3–4)	< 0.001
Total score	11 (8–32)	32 (24–32)	< 0.001

into another language and can be handled as a further investigation of the MOE with regard to establish reliability and validity of its Turkish version.

The internal consistency of the T-MOE was excellent for each item and for the total score of the T-MOE. In the study, which was performed to improve the proposed version of the T-MOE, an overall Cronbach's alpha coefficient of 0.73 was reported [12], which is also in agreement with the present study's findings. The present study also investigated the intra-observer and inter-observer reliability of the T-MOE. Two therapists analyzed and scored all of the chewing videos. The number of raters could be increased to strengthen the results; however, it is often limited due to practical and/or logistical constraints. The possible constraints are: (a) limited number of experts available in clinics, (b) limited number of experts that are willing to participate, (c) limited number of experts that are qualified to make the observations, and/or (d) limited tolerance of the subjects for replications [21]. In the present study, the experiences of the raters could strengthen the reliability results. The intra-observer and inter-observer reliability of the T-MOE were found to be excellent, indicating that the T-MOE is a consistent instrument that can be used to evaluate chewing function in children.

We found a negative and strong correlation between all of the T-MOE items and the KCPS scores, which indicates sufficient criterion-based validity. The T-MOE scores increased through increasing levels of chewing performance. This is reasonable because, in MOE, increasing levels indicate that better oral motor behaviors are required for efficient chewing, which results in better chewing performance. In addition to the results regarding the criterion-based validity of the T-MOE, the relationship between T-MOE and KCPS also has clinical importance for establishing a holistic approach for evaluating chewing function. As a criterion-referenced instrument, the MOE contains several factors that are the basis for chewing function including movement of the lips, tongue, and jaw, chewing duration, loss of food or saliva, number of swallows, and swallow coordination [12]. The KCPS was designed to define the chewing performance level by evaluating the overall chewing function without considering the isolated movements seen in the stages of chewing function. Both instruments are quickly and easily administered, and they have sufficient reliability and validity [13]. Therefore, the relationship between these two important instruments, which have similar features but a different focus, suggests that T-MOE and KCPS could be used as complementary tools evaluate chewing function in children. In the present study, typical children without chewing disorders had better T-MOE scores than children with CP suffering from chewing disorders. This result indicates that the T-MOE was able to discriminate between children with and without chewing disorders.

Further studies, including ones that translate the MOE into other languages and ones that verify the current study's results with more raters, should be designed to expand the use of this important instrument in all clinical and research settings. Moreover, future studies should also investigate whether the scale can distinguish the severity of chewing disorders in different patient groups and determine the responsiveness of the T-MOE to the progress of chewing training in children with chewing disorders.

Conclusions

The present study is the first to translate the MOE into another language. Its findings suggest that the T-MOE is a reliable and valid instrument for evaluating the observed oral motor behaviors of chewing function in children. Therefore, the T-MOE could be used as a standardized tool in clinical settings or research studies to evaluate the oral motor behaviors of chewing function in children.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent All participants signed an informed consent form.

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