LittlEARS® early speech production questionnaire validation in hearing Turkish infants

Julie Koşaner[1], Samime Sonugüler[2], Fatih Oğut[3], Tayfun Kirazlı[3], Deniz Uruk[1], Raziye Örnekçi[2], Edda Amann[4]

[1]Meders Maxtone Hearing and Speech Center, İstanbul, Türkiye, [2]SB İzmir Bozyaka EAH, Türkiye, [3]ENT Department, Ege University, İzmir, Türkiye, [4]MEDEL Worldwide Headquarters, İnnsbruck, Austria

Aim: The LEESPQ validated on hearing, German infants is a standardized tool examining preverbal speech development. This study aims to validate the LEESPQ on hearing, Turkish infants.
Materials and methods: This is a prospective, cross-sectional validation study using the LEESPQ in Turkish. The LEESPQ was filled in once for each hearing infant. Data for ≥10 infants was collected at 19 test intervals, ≥0–1, ≥1–2……, ≥18–19 months. Psychometric validation was performed through confirmatory factor analysis, item response analysis, item analysis, and analysis of reliability and validity.
Results: The LEESPQ was found to be gender independent, have high predictive accuracy and almost exclusively assess speech production ability. A very high correlation between total score and chronological age means score can be interpreted as child's speech production developmental age. Expected and minimum scores were defined for each monthly interval.
Conclusion: The LEESPQ (Turkish) has clinical value to confirm typical speech production development and detect potential problems.

Keywords: Normal hearing Turkish infants, LittleEARS test battery, Validation

Introduction

The MEDEL LittleEARS® test battery was created to evaluate hearing and speech development in very young children. The battery consists of various coordinated evaluation tools, the LittlEARS Auditory Questionnaire (Cininx *et al*., 2003), My LittleEARS Diary (Veekmans *et al*., 2005), and the Early Speech Production Questionnaire (LEESPQ) (Schramm *et al*., 2009). Very young children are unable to participate in formal tests, and questionnaires have been found to be valid diagnostic tools for assessment of abilities in infants and toddlers (Talekar *et al*., 2005). The LEESPQ can be used to document speech and language development in hearing children, children using cochlear implants or hearing aids and can be used as a screening tool. Use of the LEESPQ may aid early detection of potential disorders and thereby prompt early intervention.

The LEESPQ evaluates the first 18 months of mostly pre-verbal speech production. It examines reflexive behavior, pre-canonical vocalizations, canonical vocalizations, and post-canonical advanced forms. Speech production starts immediately after birth with Infants expressing emotions such as hunger, pain, and fear, through sounds and varied cries. From 1 to 6 months infants' speech production is characterized by pre-canonical vocalizations such as grunts, vowel like sounds, clicks, lip smacks, and raspberries. From 6 to 10 months their speech production is characterized by canonical vocalizations, e.g. rhythmic production of duplicated or non-duplicated syllables, e.g. 'didapa'. From 10 to 18 months infants use post-canonical advanced forms, e.g. closed CVC syllables, consonant clusters, jargon, and first words (De Boysson-Bardies, 1999; Karmiloff and Karmiloff-Smith, 2002).

The LEESPQ consists of 22 simple yes/no questions which examine the most important age-related milestones of early speech production development. Parents' responses are based on observations of their child's speech behavior in everyday situations. Some questions have subsets, e.g. Question 9: Does your child produce vowels? 9.1: Are the vowel sounds your child makes prolonged or short? The sub-question 9.1 provides the researcher with more detailed

Correspondence to: Julie Koşaner, Meders İşitme ve Konuşma Merkezi, Soğutlüçeşme Caddesi No 102, 34714 Kadıköy-İstanbul.
Email: julie.kosaner@meders.com.tr

DOI 10.1179/1467010014Z.000000000164

information but outcome does not affect total score. LEESPQ scores range from 0 to 31. Some questions with a low or negative correlation with age, i.e. questions examining behavior which can be observed very early were included to prevent some children scoring near zero. Such poor scores may cause parents anxiety.

The LEESPQ was validated on 352 native speaking German infants, 161 male and 168 female. Scores reflect a child's developmental age in terms of speech production. Expected and minimum scores for each monthly interval were calculated. Expected scores are the average score that children of a certain age group achieve. Scores falling within the expected range mean it is highly probable (95%) that a child's speech production ability is developing normally. Minimum score values are the levels a child of a certain age should attain. They are the lower limit of the 95% confidence interval. The probability that a child scoring below these levels has age appropriate speech production is very small <5%. Availability of normative data means scores of individual children can be compared with norms. Scores below minimum values are not necessarily an indication of abnormal speech production. The questionnaire should be repeated by a speech and language therapist to verify the first result. Once verified the child can be diagnosed with increased risk for speech and language impairment and further investigations should be made.

Presumably, early speech production may differ between languages, so to be able to use this early speech production questionnaire on Turkish infants it would first need to be validated on Turkish infants.

Objectives

The objectives of this prospective, cross-sectional study were to validate the LEESPQ on normally hearing Turkish infants and define Turkish language critical score values (expected and minimum).

Method

The LEESPQ was translated into Turkish, translated back into English and adapted into Turkish language, e.g. some consonant sounds in Question 10.1 of German LEESPQ are not used in Turkish and needed to be changed. This Turkish version of the LEESPQ was used to collect data, cross-sectionally, from parents, typically the mother, of 222 hearing Turkish infants, 115 male and 107 female. Although the LEESPQ was designed for parents to fill in themselves, to increase accuracy of reporting in this study the questionnaires were completed through interview by three researchers based in Izmir, Turkey. Infants were sourced from pediatric clinics in hospitals, friends and neighbors, nurseries and hearing siblings of cochlear implant users. All included infants had passed newborn hearing screening (NHS) and had no apparent special needs. Infants ranged in age from 8 days to 18 months. This 18-month period was divided into 18 test intervals or age categories, the number of infants tested at each interval ranged from 9 to 17 (Table 1).

Table 1 Number of infants tested at each test interval (age category)

Age (months)	Number	Age (months)	Number
0–1	13	>9–10	11
>1–2	9	>10–11	11
>2–3	16	>11–12	15
>3–4	10	>12–13	12
>4–5	17	>13–14	10
>5–6	15	>14–15	11
>6–7	13	>15–16	10
>7–8	9	>16–17	10
>8–9	13	>17–18	17

Psychometric validation was carried out on collected data. An Independent Sample *T*-test was used to check the suitability of items according to gender.

Age was correlated with total score to check if LEESPQ reflects the age dependency of speech production, Split-half reliability (r), and Guttman's lambda (λ) were used to measure how accurately a score can be predicted from age. Cronbach's alpha was used to check if the LEESPQ exclusively assesses speech production ability. The expected values, i.e. the total scores children of a certain age-group should reach, were calculated from the data of 222 Turkish hearing children. The regression of the variable 'total score' to the variable 'age' was calculated, choosing the solution (structural equation) attributing most of the variance of the dependent variable to the independent variable, according to the least squares method.

Results

The mean score on the LEESPQ for 222 hearing infants with a mean age at testing of 9 months was 20.24. There was a steady increase in expected value at each test interval from 10 at the first interval to 28 at the 18th test interval.

The LEESPQ was found to be gender independent, total scores for boys and girls were not significantly different (independent sample *T*-test: $t = 0.938$; $P = 0.349$). This result indicates that the LEESPQ is suitable for both genders and results for individual boys and girls can be compared with the calculated critical values (Table 2).

A high and very significant correlation was found between age and total score ($r = 0.850$, $P < 0.001$) demonstrating that the LEESPQ is a measure of a child's age appropriate speech production ability.

A very high Lambda of $\lambda = 0.910$, where a $\lambda = 1$ represents perfect accuracy, was calculated showing

Table 2 Expected mean values (speech production development according to age) and minimum mean values of age-dependent speech production ability

Age (months)	Expected value	Minimum value	Age (months)	Expected value	Minimum value
0–1	10	2	>9–10	22	15
>1–2	11	4	>10–11	23	16
>2–3	11	5	>11–12	24	17
>3–4	14	7	>12–13	24	18
>4–5	15	8	>13–14	25	19
>5–6	15	10	>14–15	26	19
>6–7	18	11	>15–16	27	20
>7–8	19	13	>16–17	27	21
>8–9	21	14	>17–18	28	21

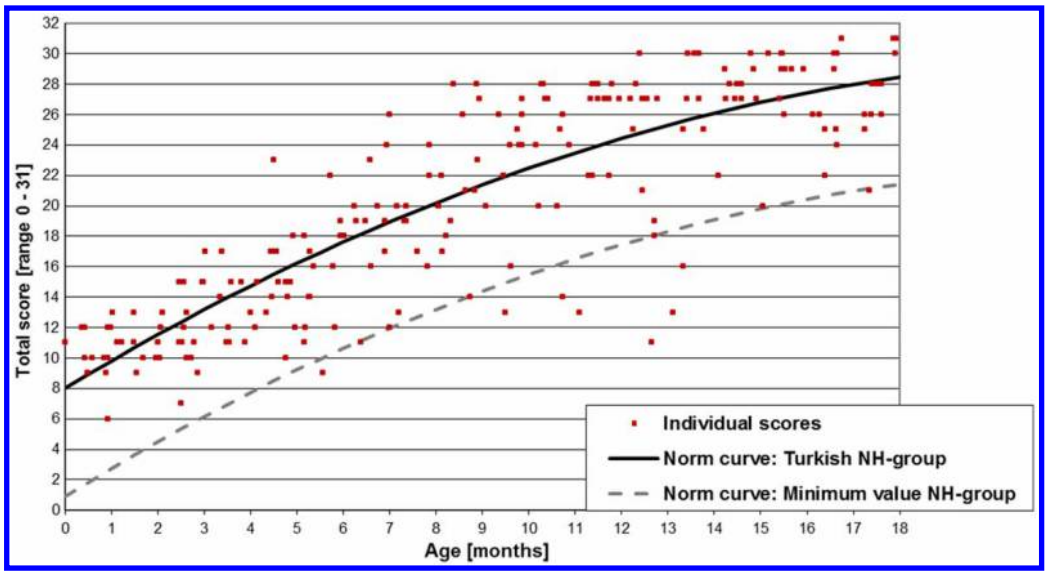

Figure 1 LittleEARS Speech Production Questionnaire – LEESPQ: Validation of Turkish Hearing Children ($n = 222$). Showing the regression curve (quadratic) with age as independent and total score as the dependent variable. Individual scores are shown as dots, standardized expected values (norm curve) are shown as a solid line and standardized minimum values (lower 95% confidence interval) are shown as a dashed line. The graph shows the age-specific speech production abilities of the Turkish normal hearing sample.

that the total score for a child can be predicted from age. Thus, the predictive accuracy of the LEESPQ is considered to be very high.

An alpha of $\alpha = 0.940$ where a value $\alpha > 0.7$ is desirable was calculated indicating the LEESPQ almost exclusively assesses speech production ability. The solution of the regression analysis was a second order polynomial ($y = 7.995 + 1.838 \times \text{age} – 0.039 \times \text{agê}2$), explaining 74% of the entire variance (adjusted $R^2 = 0.740$) (see Fig. 1). With this structural equation, the total scores for the individual month test intervals were calculated. These values are considered to be the expected values for the age-specific speech production ability of a child. The results of the regression analysis were used to determine the confidence intervals in which the age-specific values are found with a 95% probability. The values with a downward deviation (i.e. the child reaches a total score below the value of the age group) are clinically relevant. Thus, the one-sided 95% confidence interval was determined as the critical lower limit (called minimum value). If the child reaches a value above this minimum value, it can be assumed that the child has (with a probability of 95%) speech production development according to age (Table 2, Fig. 1).

Conclusion

The LEESPQ can be used to monitor the speech production ability of both boys and girls. The LEESPQ almost exclusively assesses speech production ability. A child's total score can be interpreted as a statement about a child's speech production development age. The validated LEESPQ can be used as a screening tool to aid early detection of potential problems. Early detection should lead to early intervention and thereby better remediation of problems. In addition, use of the LEESPQ should help create awareness in parents and professionals of the importance of monitoring milestones of early speech and language development.

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