

# Comparison of Early Language Skills of Premature and Full-term Infants

## Prematüre ve Term Bebeklerin Erken Dil Gelişimi Becerilerinin Karşılaştırılması

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### ABSTRACT

**Objective:** The aim of this study was to compare receptive and expressive language skills in premature and full-term babies under the newborn hearing screening follow-up program.

**Material and Methods:** A total of 130 babies were evaluated, of which 68 were premature and 62 were healthy full-term babies. Hearing function was assessed in all infants with the Transient Evoked Otoacoustic Emissions (TEOAE) and Automated Auditory Brainstem Response (AABR) tests according to hospital's screening protocol and found normal in all. Assessment of receptive and expressive language skills in both premature and full-term babies was based on the Preschool Language Scale-Fifth Edition (PLS-5) language test. PLS-5 items were applied face-to-face with the mothers of the babies, using the question-answer technique. The test time is on average 80 days for premature babies and 41 days for term babies.

**Results:** As a result of the study, no statistically significant difference was found between the two groups in terms of auditory perception and expressive language age ( $p>0.05$ ). Nevertheless, the results showed a high positive correlation between auditory perception and expressive language age in premature infants and a moderate positive correlation between the same in full-term babies. In both infant groups, auditory perception skills increase in parallel with the expressive language skills.

**Conclusion:** Premature birth is a risk factor for language development and negative effects begin to show as the premature baby grows (especially after 6-12 months). Therefore, it is important to monitor and assess premature babies during the critical age bracket of linguistic development, which is 0-2 years, for an early diagnosis and treatment of linguistic delays that may affect them later in life.

**Key Words:** Hearing, Language, Neonatal Screening, Newborn, Speech

### ÖZ

**Amaç:** Bu çalışmanın amacı, yenidoğan işitme tarama takip programındaki prematüre ve term bebeklerin alıcı ve ifade edici dil becerilerinin karşılaştırılmasıdır.

**Gereç ve Yöntemler:** Çalışmada 68 prematüre ve 62 term bebek olmak üzere toplam 130 bebek değerlendirilmiştir. Bebeklerin tamamının işitme fonksiyonları hastanenin tarama protokolüne göre Transient Evoked Otoacoustic Emissions



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(TEOAE) ve Automated Auditory Brainstem Response (AABR) testleri kullanılarak yapılmıştır. Prematüre ve term bebeklerin alıcı ve ifade edici dil becerilerinin değerlendirilmesinde Okul Öncesi Dil Ölçeği-5 kullanılmıştır. Test maddeleri bebeklerin anneleri ile yüzyüze görüşülerek, soru cevap tekniği ile uygulanmıştır. Test zamanı prematüre bebekler için ortalama 80 gün, term bebekler için ise 41 gündür.

**Bulgular:** Çalışma sonucunda her iki grup arasında işitsel algı ve ifade edici dil yaşları bakımından istatistiki olarak anlamlı farklılık bulunmamıştır ( $p>0.05$ ). Bununla birlikte, sonuçlar prematüre bebeklerde işitsel algı ile ifade edici dil yaşı arasında yüksek pozitif bir korelasyon, term bebeklerde ise orta pozitif bir korelasyon göstermiştir. Her iki grupta da işitsel algı becerilerinin ifade edici dil becerilerine paralel olarak artış gösterdiği görülmektedir.

**Sonuç:** Prematüre doğum dil gelişimi için bir risk faktörüdür ve prematüre bebek büyüdükçe (özellikle 6-12 ay sonra) olumsuz etkiler görmeye başlar. Bu nedenle, prematüre bebekleri, dil gelişiminin kritik yaş aralığı olan 0-2 yaş aralığında izlemek ve değerlendirmek, daha sonraki yaşamlarında onları etkileyebilecek olan dil gecikmelerinin erken teşhis ve tedavisi için önemlidir.

**Anahtar Sözcükler:** İşitme, Dil, Yenidoğan tarama ,Yenidoğan, Konuşma

## INTRODUCTION

Each year approximately 15 million babies are born before term (<37 weeks of gestation) worldwide. According to the World Health Organization (WHO), premature birth rate in the world is between 5-18%, whereas this rate is 10-11% in Turkey (1-3). In the US, Canada and in European countries, this rate ranges from 4.4 to 10% (4).

And the number of preterm infants is on the increase despite technological and medical advancements in antenatal care. Premature infants are born before completing the normal term of 38-42 weeks, i.e. born before the 37<sup>th</sup> week of gestation (5-7). Babies are considered mildly premature if born before the 37<sup>th</sup> week, moderately premature before the 32<sup>nd</sup> and extremely premature before the 28<sup>th</sup> weeks (8,9). Furthermore, the birth weight of a baby is considered low if it is less than 2.500 gr, very low if under 1.500 gr and extremely low if less than 1.000 gr (10). The lower the birth weight and the earlier the birth week, the higher is the risk of brain immaturity or developmental problems (11).

Prematurity is one of the most important factors in neurodevelopmental delay and many of the surviving premature babies have to face lifelong challenges such as learning disabilities, as well as loss of vision and hearing (1,12).

Besides problems in visual, auditory, and mental functions, developmental areas such as fine and gross motor skills, language development, and academic skills were investigated in premature babies and it was found that 45% experienced difficulties in at least one of these areas (13-16). Furthermore, the severity of the inadequacy in development tends to be at a higher rate with premature babies and the deficiencies are mostly to be found in the cognitive domain. Preterm babies may experience inadequacies in the first two to three years of life, typically in terms of visual attention, information processing skills, and language development (17).

Even though studies in the field suggest a higher rate of developmental problems in preterm as opposed to full-term babies, other studies show that most premature babies at <32 gestation weeks close the gap with mature babies in terms of neurodevelopment and life expectancy in the long run (18-21).

As is the case in other areas of development, premature birth is also associated with an increased risk of delay in language development. Therefore, it is important to monitor and evaluate premature babies in this regard. Early intervention may keep the risk of developmental delay at a minimum or may even eliminate it completely (9). The language development of premature babies, who have similar characteristics to term babies in the early months, may appear as a delay in auditory perception and expressive language after 6-12 months. Although there are different studies in the literature evaluating language development in premature babies using general development tests, this study is the first to compare premature and term babies with a standard language test. The aim of this study is to compare the receptive and expressive language skills of premature and term babies in the neonatal follow-up program and to raise awareness on this issue by drawing attention to the importance of the subject.

## MATERIAL and METHODS

In this study, 130 babies born between March and December 2018 were evaluated. The study was carried out by Zekai Tahir Burak Education and Research Hospital for Women's Health in Medicine Educational Board Decision, Ankara, Turkey (Dated 06.03.2018, Project Number: 5). The research group of the study included 68 premature babies born in Zekai Tahir Burak Education and Research Hospital for Women's Health and was under treatment in the Newborn Intensive Care Unit (NICU) of the same institution, with a mean age (in days) of  $80.00 \pm 37.28$ . On the other hand, in the control group there were 62 healthy infants born in the same hospital at full term and with a normal weight – the mean age (in days) was  $40.45 \pm 15.05$ .

Of the 68 premature babies, 36 (52.9%) were male and 32 (47.1%) were female; whereas in the control group with 62 full-term babies the same figures were 34 (54.8%) to 28 (45.2%), respectively. Table I shows age, gestational age, birth weight and length of time in the NICU for both groups.

Hearing function, evaluated in all infants with the TEOAE and AABR tests according to hospital's screening protocol, was found normal in all. Under the hospital's protocol, healthy newborns are first screened for hearing with the TEOAE test and

those who fail the test twice are tested with AABR. However, all newborns considered under risk are screened only with the AABR test. The tests were carried out using the MAICO MB 11 BERAPHONE device set to 35 decibels (dB) and the 'Chirp' stimulus signal was used. All babies in both groups underwent a neonatal hearing screening program and their hearing was found normal.

Demographic information about infants and their parents were collected through the General Information Form prepared by the researchers and receptive and expressive language skills of premature and term babies were evaluated according to the Preschool Language Scale-Fifth Edition (PLS-5) language test. The most important point to be considered when examining the development of premature babies is the use of "corrected age". Corrected age, from the chronological age of the baby that was born prematurely. It is obtained by subtracting the number of weeks. In our study, corrected age was used in the language assessment of premature babies.

Prior to the study, mothers were informed about the aims and procedures, as well as the nature of the test to be performed. Those who agreed to take part in the study signed the informed consent form. All data was collected in line with applicable ethical principles.

## Data Collection Tools

### 1. General Information Form

The General Information Form consists of questions about the baby (including the date of birth, sex, birth week, birth weight, length of stay in the NICU) and about the family/parents (education, occupation, socioeconomic status, etc.).

### 2. Preschool Language Scale-Fifth Edition (PLS-5)

Preschool Language Scale-5 (PLS-5) is a language assessment test commonly used worldwide for children from 0 to 7 years 11 months of age in order to identify any delays or disorders in auditory perception and expressive language development. It was developed and first used by Zimmerman, Steiner and Pond in 2011 (22). The test was adapted to Turkish by Sahli and Belgin, who also tested it in terms of validity and reliability. The Turkish Preschool Language Scale-5 (TPLS-5) proved itself as a legitimate and reliable test for the assessment of language and speech skills in Turkish-speaking children. In this study, Pearson correlation coefficients for standard TPLS-5 scales were, respectively, Auditory Perception (AP) Raw Score 0.937, Expressive Language (EL) Raw Score: 0.908 and Total Language Score (TLS): 0.926. As for the correlation coefficients for age equivalence, AP: 0.871, EL: 0.896, and TLS: 0.887 (23). The test consists of a Picture Booklet, Record Form, and Manipulatives (specific objects and toys) and its length varies according to the age, ability, and cooperativeness of the child. There are 2 standard scales in TPLS-5 (24).

1. Auditory Perception (AP) Scale assesses child's level of language comprehension. Using the materials designed

for preschoolers it is possible to evaluate basic words, concepts, form knowledge and early syntax. Test questions prepared for children aged 5, 6, and 7 help evaluate the ability to understand complex sentences, use language for comparisons and inferences, and the newly developing literacy skills (23,24).

2. Expressive Language (EL) Scale assesses communication skills of preschool children. They are asked to count known objects, use concepts to define objects, express quantities, and use specific prepositions, grammatical signifiers, and sentence structures. Questions designed for the 5-7 age group assess the newly developing literacy skills (e.g. phonological awareness and recounting the events from a short story in the correct order) and holistic language skills (e.g. use of analogies, synonyms and word classification) (23, 24).

In very young children (eg 0- 2 years old), PLS-5 items are administered by obtaining information from the caregiver regarding the child's ability to exhibit target behaviors. In our study, test items were applied face-to-face with the mothers of the babies, using the question-answer technique. The test was applied by an Audiology and Speech Disorders expert with PLS-5 application certificate.

## Statistical Analysis

In the statistical analysis, the software package IBM SPSS for Windows Version 20.0 was used. Numerical variables were summarized with mean±standard deviation. Categorical variables were indicated by numbers and percentages. Kolmogorov Smirnov test was used to check whether the distribution of the numerical variables was normal and variance homogeneity was checked using Levene test. In the study of any differences between premature and healthy newborns, the independent samples t test was used where parametric test assumptions were available. Pearson correlation test was used to determine the relationship between premature and healthy newborns in terms of auditory perception and expressive language. A further comparison of the two infant groups with respect to certain variables and hearing loss was performed using the t test. The significance level was  $p < 0.05$ .

## RESULTS

The mean gestational age of the 68 premature infants in the study was  $30.96 \pm 2.62$  (Min: 25-Max:34) weeks, mean birth weight was  $1.750 \pm 607.14$  grams and the mean duration of NICU stay was  $32.71 \pm 28.57$  days. The same values for the 62 term babies in the control group were respectively  $38.10 \pm 1.72$  weeks,  $3.047 \pm 546.18$  grams and  $5.56 \pm 5.41$  days (Table I). Delivery was by caesarean section in 82.4% of premature babies and 53.2% of those in the control group.

**Table I:** Characteristics of premature and full-term babies (n=130).

	Premature (n=68)	Full-Term (n=62)
	Mean ± SD	Mean ± SD
The chronological age (day)	80.00 ± 37.28	40.45 ± 15.05
The mean gestational age (week)	30.96 ± 2.62 (Min:25-34)	38.10 ± 1.72 (Min:37-41)
The mean birth weight (gram)	1.750 ± 607.14	3.047 ± 546.18
The mean duration of NICU (day)	32.71 ± 28.57	5.56 ± 5.41

NICU: Newborn Intensive Care Unit, SD: Standard Deviation

**Table II:** Auditory perception and expressive language ages of premature and term babies according to TPLS-5 test.

	Auditory perception		Expressive language	
	Mean ± SD	t and p	Mean ± SD	t and p
Premature	6.81 ± 1.25	p=0.306	7.09 ± 0.54	p=0.416
Full-Term	6.63 ± 0.61	t=1.028	7.02 ± 0.46	t=0.815

SD: Standard Deviation

**Table III:** Auditory perception and expressive language age in premature and full-term babies based on sex.

		Male	Female	t and p
		Mean ± SD	Mean ± SD	
Premature	Auditory Perception	7.11 ± 1.41	6.47 ± 0.95	t=2.175, p=0.033
	Expressive Language	7.19 ± 0.58	6.97 ± 0.47	t=1.750, p=0.085
Full-Term	Auditory Perception	6.65 ± 0.60	6.61 ± 0.63	t=0.256, p=0.799
	Expressive Language	7.03 ± 0.46	7.00 ± 0.47	t=0.248, p=0.805

SD: Standard Deviation

As for the parent background, in the group of mothers who gave birth to premature babies, 29.4% graduated high school, 26.5% had a degree from the university (Bachelor's or further), 23.5% completed secondary education and 20.6% only primary education; whereas 43.5% of the mothers of full-term/healthy infants were primary school graduates, 21% graduated secondary school, 17.7% high school and 17.7% had a university degree. The education level of the mothers of premature babies was significantly higher than that of the mothers in the control group ( $p < 0.05$ ). The percentage of homemakers/unemployed mothers was 76.5% (n: 52) in the premature group and 82.3% (n: 51) in the control group.

As for the fathers of premature babies, 36.8% graduated high school, 25% had a university degree (Bachelor's or further), 23.5% completed primary and 14.7% secondary education; whereas, of the fathers with a term/healthy baby 32.3% graduated high school, 29% secondary school, 21% primary school and 17.7% had a degree from a university (Bachelor's or further). No statistically significant difference was found between the education level of fathers in two groups ( $p > 0.05$ ). While most (64.7%) of the fathers with premature babies were self-employed, 40.3% in the control group were employees. Although the socioeconomic status was more or less the same in the two parent groups, the monthly income of the families with premature infants was higher to a statistically significant degree ( $p < 0.05$ ).

In Table II, the results of the auditory perception and expressive language age are given according to the TPLS-5 test of premature and term babies. The mean auditory perception linguistic age of preterm infants was found  $6.81 \pm 1.25$ , whereas the same parameter was  $6.63 \pm 0.61$  for term babies. This means there was no statistically significant difference between the two groups in terms of auditory perception age ( $p = 0.306$ ,  $t = 1.028$ ). As for the mean age of expressive language, it was found  $7.09 \pm 0.54$  in the premature group and  $7.02 \pm 0.46$  in term babies. This also means that there was no statistically significant difference between the groups of premature and term babies in terms of mean age of expressive language ( $p = 0.416$ ,  $t = 0.815$ ).

Table III shows the distribution of auditory perception and expressive language ages in premature and term babies according to sex. A study of the mean ages of auditory perception and expressive language in both groups shows a higher mean age in male babies. However, this difference between sexes was statistically significant only in terms of the mean age of auditory perception in premature babies ( $t = 2.175$ ,  $p = 0.033$ ).

Table IV shows the relation between auditory perception and expressive language age in premature and full-term babies. In terms of the relation between auditory perception and expressive language, the results suggest a highly significant positive correlation in premature babies and a moderately

**Table IV:** Correlation between auditory perception and expressive language age in premature and full-term babies.

		Auditory Perception	Expressive Language
<b>Auditory Perception</b>	Premature	1.000	-
	Full-Term	1.000	-
<b>Expressive Language</b>	Premature	0.713	1.000
	Full-Term	0.256	1.000

significant positive correlation in term babies. In both groups, auditory perception skills increase in parallel with expressive language skills.

## DISCUSSION

Prelinguistic skills begin to develop immediately after birth and the prelinguistic phase of development involves non-verbal communication through gestures and mimics. Healthy newborns follow a typical language development model, in which they acquire the skills needed to master communication, including gestural, pragmatic, play, and attachment style interactions.

In the case of premature infants, however, prelinguistic and linguistic development stages may be delayed or different (25). Auditory discrimination skills develop in the first few months of life and newborns begin to distinguish speech from non-linguistic sounds. Around 6-12 months, the baby distinguishes native language. However, the delay in neural development in premature infants may affect phoneme differentiation skills. This delay in neural development may in turn cause delays in the language development process, resulting in an inadequate discrimination of speech and non-speech sounds (26).

The body of studies on language development in premature infants shows a variation based on age. Language skills of premature babies do not differ much from the control group in the first six months, but the likelihood of delays in linguistic development increases with age (27).

In a study on the development of premature babies, Ozbek (28) found a statistically significant delay in the linguistic and cognitive development of preterm infants compared to the control group. Similarly, Karaaslan (29) assessed the development of 30 premature children in the age range of 24-42 months and found that 10 children had problems in at least one developmental area and 8 in the area of linguistic-cognitive development. In another study assessing growth, neurological and developmental state of 128 premature infants between the ages of 12-18 months, 10 of the children showed language delays (30). Also, studies on the long-term development in premature infants suggest difficulties in articulation and significant delay in verbal expression skills at the mean age of five years (31).

However, along with the studies suggesting delays in language development in premature babies, there are those emphasizing that linguistic skills in premature and term babies develop in

a similar fashion. Another study conducted with 40 preterm and 40 full-term babies found no significant difference in terms of language development. In the same study, it was found that the birth week was a factor on the development of premature babies and the chances for a normal language development increased with the birth week (32). Another study on the language development in premature and full-term babies compared 12 preterm babies born before 34 weeks and with a birth weight of less than 1.500 gr with 20 full-term babies with regard to cognitive and expressive language development. It was observed that cognitive and expressive language development progressed similarly in both groups until the 6th month, but a significant difference between two groups began to occur thereafter. The study concluded that it was of crucial importance to determine the developmental needs of children with a low birth weight at an early stage and provide them the necessary support (33). In our study, infants younger than 6 months were evaluated and, similar to the results of the forementioned study, it was found that the developmental stages in preterm and full-term babies were similar in the domains of auditory perception and expressive language. Furthermore, in both groups auditory perception skills increased together with expressive language skills. To conclude, many of the studies in the field suggest that language delay in premature infants begin to show with advancing age (27,30-33). Therefore, it is crucial to evaluate receptive and expressive language development in premature babies with regular intervals and inform families on the follow-up.

In summary, most of the studies on the subject show that premature babies show similar characteristics to term babies in terms of their auditory perception and expressive language development in the first months. The important point here is that although the language test results applied to premature babies show normal results in the first months, the babies continue to be followed up in terms of language development. In our study, we compared the receptive and expressive language skills of premature babies and term babies with a standard language test and reached a significant number of cases. Despite this, there are some limitations in our study (e.g. the lack of need of resuscitations, APGAR scores or comorbidite diseases). With different studies to be carried out in the future, it may be suggested that premature babies should be examined in more detail according to their different characteristics, divided into groups and to follow their language development at regular intervals for a longer period (for example, up to 2 years old).

## CONCLUSIONS

Premature birth is a risk factor for language development and its undesired effects in prematurely born babies begin to show with age. Studies show the likelihood of delays in auditory perception and expressive language in premature infants after 6-12 months of age. Therefore, it is of crucial importance to monitor and assess premature babies during the critical age bracket of linguistic development, which is 0-2 years. This allows for early intervention, which in turn helps determine any likelihood of delays in auditory perception and expressive language development in later months and take necessary measures in a timely manner.

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