Do the Children of Mothers with Optimum PICCOLO Scores Have Better Denver II Test Results?

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ABSTRACT

Aim: Positive parenting skills, especially mother–child interactions, are associated with positive effects in countless areas of child development. We aimed to evaluate mother–child interactions in children with developmental delay compared to those with age-appropriate development.

Material and Methods: Children aged 1-5 years admitted to the outpatient clinic for child health supervision were evaluated for the study. A 10-minute video recording was obtained while the participant mother–child couple played together in a room. Children were divided into 3 developmental groups using the Denver Developmental Screening Test II (DDST-II): as age-appropriate, questionable, and delayed. Mother–child interaction was assessed using the “Parenting Interactions with Children: Checklist of Observations Linked to Outcomes” (PICCOLO) tool.

Results: A total of 142 children, whose developmental status was evaluated according to DDST-II and were grouped as age-appropriate (59), questionable (39), and delayed (44), were included in the study. The mean age of the children was 29.0 ± 11.9 months. The median PICCOLO score was 43 (interquartile range (IQR)=36-47) in the age-appropriate group, 44 (IQR=35-51) in the questionable group, and 36 (IQR=32-45) in the delayed group. When adjusted for child’s age, gender, presence of a sibling, maternal age, mother’s education level, mother’s occupation, and household size, multiple logistic regression revealed higher rates for optimum responsiveness and encouragement domains, and total scores in age-appropriate and questionable groups, than in the delayed development group (P < .05).

Conclusion: Supporting all areas, especially the responsive and encouragement domains in mother–child interactions, may improve child development.

Keywords: Mother–child interaction, PICCOLO, Denver developmental screening test II

INTRODUCTION

The basis of physical and behavioral problems that may occur throughout life is formed in early childhood. Many factors in this period may affect the mental, cognitive, motor, and language development of the child. Positive mother–child interaction is one of the factors associated with positive outcomes in many areas of child development. The mother’s behavior and competency in fulfilling the baby’s needs affect mother–child interactions. Positive interactions of babies with their mothers make them more curious about the environment and allow them to be more open to discovering the surrounding objects. In addition, the feeling of affection and trust increases babies’ courage, thereby increasing their experience of the world, and consequently, the number of neuronal synapses.

Identifying areas that are affecting the child’s development in a parent–child relationship allows us to advise families to assist the child’s development. Results obtained in this direction...
help identify families at risk and may provide guidance for programs that support sensitive and responsive parenting. The "Parenting Interactions with Children: Checklist of Observations Linked to Outcomes" (PICCOLO) tool also provides an unbiased assessment of parental interaction. The Denver Developmental Screening Test II (DDST-II) can help to better understand how we can improve children's development. In this study, we aimed to evaluate whether mother–child interactions involving affection, responsiveness, encouragement, and teaching differ between children with developmental delays and children with age-appropriate development.

METHODS

Study Design and Population
This descriptive study includes 1- to 5-year-old healthy children, applying consecutively to a pediatric clinic for a routine screening or check-up between January 2018 and June 2018. During this period, there were 912 children aged 1-5 years who applied to the outpatient clinic for routine control. Among them, 142 mother–child couples (15.5%) who agreed to participate in the study were included.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethical Committee of University of Health Sciences, Ankara Child Health and Diseases Hematology Oncology Training and Research Hospital. (Protocol Code: 2015-017).

The parents of all children were informed about the study and their written informed consent was obtained.

Children who had a gestational age of >37 weeks, birth weight of >2500 g, and no genetic syndrome, neurological diseases, psychiatric disorders, or pervasive developmental disorders (such as autism spectrum disorder) were included in the study. However, children with hearing loss and mothers with any chronic diseases or psychological disorders were not included in the study, and those who were Denver 'not testable' or were not compatible during the video recording were also excluded. Parents who did not give consent and permission for video recording were not taken for the study.

All volunteering mother–child dyads meeting the enrollment criteria were recruited. We continued to enroll children until 40 abnormal and 40 questionable cases were taken. During the study period, 59 mother–child dyads in the age-appropriate DDST group, 39 in the questionable DDST group, and 44 in the delayed DDST group met the criteria.

Data Collection
Demographic characteristics of the children and their families were obtained via a questionnaire structured by the researchers; prenatal, natal, and postnatal histories were recorded in a survey form. Mother–child interactions were assessed by the PICCOLO tool. DDST was applied to evaluate developmental steps.

We provided a room with toys suitable for the children's age where the mother and the child could play together. The same environment and toys were used for all the children that participated in the study. The mothers were asked to play with their children the same way they play at home, to play as if they were at home. A 10-minute video recording was obtained while the mother was playing with her child. After the video recording, DDST-II was performed on children.

Parenting Interactions with Children Checklist of Observations Linked to Outcomes (PICCOLO) tool
The video recordings were evaluated using the PICCOLO tool created by Rogmann et al., with a checklist of 29 traceable behaviors, to determine parenting interaction with children in 4 areas: affection, responsiveness, encouragement, and teaching. We used the Turkish version of the PICCOLO tool which was validated by Bayoglu et al. Each of the 4 PICCOLO fields contains 7 to 8 items of observable parenting behavior, each with a short label and a more detailed description of the behavior. Each item is scored as: 0 (absent, no behavior was observed); 1 (barely, brief, minor, or emerging behavior was observed); or 2 (clearly, definite, strong, or frequent behavior was observed). A score of 42 or higher was accepted optimum for the PICCOLO total, 11 or higher was accepted optimum for PICCOLO-affection, PICCOLO-responsiveness, and PICCOLO-encouragement, and 9 or higher was accepted optimum for PICCOLO-teaching. The scores were evaluated and compared to the predetermined values, and the mean scores were also calculated.

Denver Developmental Screening Test II (DDST-II)
The DDST-II version standardized for Turkey was performed by 2 trained and certified pediatric specialists. The test contains a total of 134 points in 4 developmental areas: personal-social (21 items), fine motor (33 items), language (42 items), and gross motor (38 items). The test results in 4 possible evaluations: normal, abnormal, suspicious, and non-testable. The result is scored as: Normal, When there is no delay in any component; Abnormal, 2 or more delays; Questionable, 1 delay and/or 2 or more warning signs. The DDST-II normal children formed an "age-appropriate DDST group," the questionable ones formed "questionable DDST group," and abnormal ones formed the "delayed DDST group." The mothers were provided education on child development and care depending on their scores. All patients were followed-up, children with developmental delays were called for earlier control.

Statistical Analysis
Statistical analyses were performed using the IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA). Shapiro–Wilk test was used to check whether the continuous variables in the study were normally distributed. Normally distributed variables were presented in mean±standard deviation, non-normally distributed variables were presented in median and interquartile range (IQR: percentile 25-75), and the categorical variables were expressed as percentage. One-way analysis of variance (ANOVA) or Kruskal–Wallis test was applied for group comparisons where appropriate. When the null hypothesis was rejected in one-way ANOVA, Duncan pairwise comparisons were evaluated. Univariate logistic regression analysis evaluated the percentages of normal rates for each PICCOLO domain among Denver groups (age-appropriate and questionable DDST vs. delayed DDST). After controlling child’s age, gender (male vs. female), presence of
sibling (yes vs. no), maternal age, education (high vs. low), occupation (yes vs. no), and household size (≥ 5 vs. < 5), the multiple binary logistic regression analysis (enter method) revealed normal rates for each PICCOLO domain among Denver groups. The odds ratio and 95% confidence intervals were calculated. A P value of ≤ .05 was accepted as statistically significant.

RESULTS

A total of 142 mother–child dyads’ videos and Denver screening test results were evaluated. The general characteristics of children and parents, and the distribution of PICCOLO domain scores by groups are shown in Table 1. There were no statistically significant differences between the age-appropriate DDST (n = 59), questionable DDST (n = 39), and delayed DDST (n = 44) groups in terms of gender and age of the children, mother’s age, mother’s educational level, employment status of the mother, and care at home or in kindergarten (Table 1). The median score of responsiveness was detected to be considerably lower in the delayed DDST group than other groups (P < .05, Table 1). Cases of questionable DDST had higher encouraging scores than the delayed DDST group (P < .05, Table 1). The median PICCOLO total score was found to be significantly lower in the delayed DDST group than other groups (P = .006, Table 1).

The Denver II developmental screening test results according to the developmental areas in the questionable and delayed DDST groups are summarized in Table 2, to explain the developmental areas that are being delayed.

Comparisons of the optimum scores of PICCOLO for each domain and PICCOLO total score between the age-appropriate DDST, questionable DDST, and delayed DDST groups are shown in Table 3. Frequencies of optimum scores for PICCOLO-responsiveness were seen to be lower in cases having delayed DDST. Cases having age-appropriate DDST and questionable DDST have 2.4 (95% CI: 1.1–5.6) and 2.8 (95% CI: 1.1–7.2) times more optimum scores for PICCOLO-responsiveness compared to cases of delayed DDST. Compared to delayed DDST, optimum scores for PICCOLO-encouragement were detected to be 2.6 and 2.8 times more for age-appropriate DDST and questionable DDST, respectively. Frequencies of optimum scores for PICCOLO-teaching were 2.5 times higher in questionable DDST, questionable DDST, and delayed DDST groups (Table 3).

When adjusted for child’s age, gender (male vs. female), presence of a sibling (yes vs. no), maternal age, mother’s education level (high vs. low), mother’s occupation (yes vs. no), and household size (≥ 5 vs < 5), the multiple logistic regression revealed higher rates for optimum responsiveness, encouragement domains, and total scores in cases having age-appropriate and questionable DDST than delayed ones (Table 3).

DISCUSSION

In the study, the mother–child interaction scores were lower in the delayed DDST group. This was also compatible with the literature; it has been mentioned in studies that the positive

### Table 1. Demographic Characteristics and the Scores of PICCOLO for Each Domain According to DDST-II

| Characteristics                  | Age-Appropriate DDST | Questionable DDST | Delayed DDST | P   |
|----------------------------------|----------------------|-------------------|--------------|-----|
| N                                | 59                   | 39                | 44           |     |
| Children’s age, months*          | 29.4 ± 12.1          | 28.6 ± 10.1       | 28.8 ± 13.3  | .946|
| Children’s gender, male, %       | 49.2                 | 41.0              | 59.1         | .256|
| Single child, %                  | 49.2                 | 33.3              | 43.2         | .301|
| Maternal age, years*             | 29.3 ± 4.8           | 28.6 ± 5.3        | 30.6 ± 4.1   | .151|
| Maternal educational level ≥ High school or higher, % | 52.5 | 41.0 | 61.4 | .180|
| Maternal employment, working, %  | 22.0                 | 7.7               | 18.2         | .173|
| Paternal age, years*             | 32.3 ± 4.2           | 32.9 ± 5.1        | 32.7 ± 5.9   | .814|
| Paternal educational level ≥ High school or higher, % | 50.9 | 48.7 | 47.6 | .959|
| Kindergarten, %                  | 6.6                  | 2.6               | 13.6         | .159|
| Household size ≥5, %             | 23.7                 | 46.2              | 27.3         | .051|
| PICCOLO domains**                |                      |                   |              |     |
| Affection                        | 11 (9-14)            | 12 (9-13)         | 10 (7-12)    | .117|
| Responsiveness                   | 12 (10-14)a          | 12 (11-14)b       | 11 (8-12)c   | .005|
| Encouragement                    | 11 (9-13)ab          | 11 (9-14)b        | 10 (7-11)c   | .012|
| Teaching                         | 8 (6-11)             | 9 (5-11)          | 7 (5-10)     | .258|
| Total scores                     | 43 (36-47)b          | 44 (35-51)a       | 36 (32-45)b  | .006|

DDST, Denver Developmental Screening Test; PICCOLO, Parenting Interactions with Children: Checklist of Observations Linked to Outcomes.

*Mean ± standard deviation, compared with one-way ANOVA.

**Median (25th-75th percentile), compared with Kruskal–Wallis test.

a,bDifferent letter denotes significant differences between groups.

### Table 2. Delayed items in Denver II developmental screening test results according to the developmental areas

| Developmental areas | Questionable DDST n (%) | Delayed DDST n (%) |
|---------------------|-------------------------|--------------------|
| Personal-social     | 2 (5.1)                 | 23 (52.3)          |
| Language            | 2 (5.1)                 | 31 (70.5)          |
| Fine motor          | 4 (10.3)                | 26 (59.1)          |
| Gross motor         | 2 (5.1)                 | 20 (45.5)          |
The attachment and interaction between the child and the mother are essential for a child's social skills, emotional adaptation, and cognitive development.\(^{19}\) It is the praise and approval of the mother that enables the learning and reinforcement of new skills for children.\(^{5}\) A positive maternal attitude is associated with higher cognitive development, while negative maternal behavior is associated with poor emotional self-regulation and noncompliant behavior.\(^{20, 21}\)

We detected that the mothers' responsiveness and encouragement scores were higher in the normal and questionable DDST groups in comparison with the abnormal DDST group. We found limited data on the subject in the literature. It is likely that the mothers' responsiveness and encouragement are the reasons behind the children's development. Children need encouragement and proper environmental stimulation for them to reach their highest level of development.\(^{5, 22}\) A positive maternal attitude is associated with higher cognitive development, while negative maternal behavior is associated with poor emotional self-regulation and noncompliant behavior.\(^{20, 21}\)

We can not say inadequacy of the mothers' responsiveness and encouragement led to developmental delay. However, we can say that children with abnormal results in DDST had low mother–child interaction encouragement and teaching scores. These results may inspire new studies in mother–child interaction.

Moreover, a review of studies by Rocha et al.\(^{24}\) has emphasized that the quality of the relationship between a child and parent is an important factor influencing a child's early development. Parents provide developmental support through cognitive stimulation and social interaction with their children. Especially, favorable parenting interaction during infancy and early childhood, and general support in all respects, contribute to children's further cognitive results. On the other hand, there is a probability that the delayed development of their children discouraged mothers from interacting with them. Delayed development may have caused the mothers to lower their expectations about their children's abilities, thus leading them to decrease the level of encouragement they gave to their children.\(^{25}\) Similarly, the mothers' scores of responsiveness may be low because their children have failed to give them the correct signals during their development, causing the mothers to dismiss the signals their children give.\(^{22}\)

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Our study has some limitations. Firstly, this was a single-center study, the sample size was limited. Besides, the enrollments of mother–child pairs were not randomized and only those who allowed video recording were included in the study, which limits the dissemination of the results to the the community.
Secondly, each of the “gross motor-adaptive, language, fine motor and personal-social” developmental areas were not examined separately because of the limited number of cases. Thirdly, we aimed to evaluate mother–child interaction in the same environment; however, the home environment could not be provided. Furthermore, it should be considered that the existence of more than one caregiver for a child is probable. The higher optimum teaching scores in the questionable DDST groups can be explained by the fact that mothers who think their children have developmental problems spend more time with their children and they may have asked for their children to be evaluated. However, we did not collect information about how mothers evaluated their children’s development or had concerns about their development. Lastly, the patients were not followed-up regularly, so their previous and subsequent follow-ups could not be obtained. Additionally, the cross-sectional nature of the study limits drawing a conclusion on the etiology and outcome. On the other hand, our study has several strengths. First of all, this was the first study to evaluate mother–infant interactions with standard tools in a standard environment. Our study also detected the value of responsiveness and encouragement on preschool child development, and that teaching and affection had no significant effect.

In conclusion, mothers’ responsiveness and encouragement scores were low in children with abnormal Denver test results. It is important to evaluate mother–child interactions, especially in children with abnormal Denver results, more carefully in order to support the mother on this issue. It is substantial to measure the development of early detection of parents’ inadequacies and early intervention. Strengthening responsiveness and encouragement areas in early mother–child interactions can lead to better developmental outcomes.

Further studies could be planned to detect parenting interactions on subscales of DDST. Prospective studies are necessary to determine the effect of improvement of mothers’ responsiveness and encouragement skills on children with abnormal DDST results.

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