

Breastfeeding Duration More than 18 Months Possibly Lowers the Risk of Language Development Delay in Children Aged 18–35 Months

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Abstract

Studies have demonstrated the benefits of breastfeeding (BF) on children's cognitive function and language development. However, most cognitive and language tools used in these studies have limited ability to identify children's language development delays. The Language Development Survey (LDS) is expected to provide detailed information on children's language development. This study aimed to examine the association between BF duration and children's LDS. A questionnaire was administered to 286 BF mothers to obtain information on their BF duration, and LDS was employed to assess children's language development. Language delays were detected in 91 (31.8%) children (LDS-vocabulary) and 35.7% children (LDS-phrase). This study also found that children who were breastfed for ≤ 6 months and 7–18 months had an adjusted OR (AOR) of 0.86 of LDS-vocabulary, and 0.8 of LDS-phrase, whereas children who were breastfed for >18 months had AOR's LDS-vocabulary of 0.57 and LDS-phrase of 0.46. This study found no significant association between BF duration and LDS score. Nevertheless, BF duration of >18 months possibly lowers the risk of children's language development delay. More studies are required to investigate this observation's relationship with children's language development.

Keywords: breastfeeding, language development survey, phrase, vocabulary

Introduction

Breastfeeding (BF) benefits children's immune systems and determines their health and physical growth. Regarding cognitive development, the impact of BF duration on children's language development remains an ongoing debate. A study in Korea argues that the apparent advantages of "longer breastfeeding duration" on language development are often confounded by factors such as sociodemographic contexts, which should be considered in the analysis.¹ Furthermore, children's language development has rarely been assessed thoroughly.² Although some studies have extensively explored the relationship between BF and children's development, they focused less on language development.^{3,4}

Pre-screening Developmental Questionnaire (PDQ) or Denver Developmental Screening Test (DDST) is the most widely applied assessment tool to assess children's cognitive and language development, especially in Indonesia.⁵ However, some scholars in a review study have criticized the tool's limitation in determining comprehensive language assessment.⁶ This tool assesses chil-

dren's language development using only 1-2 questions, resulting in vague diagnoses and recommendations about children's language ability. Consequently, the diagnosis of children's language development problems may be delayed. The limitations of the DDST indicate that employing a more comprehensive method to assess, diagnose, and further provide recommendations on children's language development is crucial in assessing children's cognitive and language development.

To address this concern, this study employed the Language Development Survey (LDS), known for its excellent test-retest reliability and internal consistency, along with its high sensitivity and specificity in identifying language delays in children through detailed and specific words or vocabulary lists.² Furthermore, the LDS's advantages in identifying children's language development have been confirmed by several studies in various contexts, including in Korea,⁷ Italy,⁸ and Poland.⁹ By employing LDS, this study was expected to provide comprehensive data on children's language development in the Indonesian context, which remains underexplored,

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Received : September 08, 2022
Accepted : October 19, 2022
Published : November 30, 2022

especially when the development is attached to BF practices. Therefore this study primarily focused on the association between BF duration and children’s language development using LDS.

Method

A cross-sectional study was consecutively conducted at four primary health care (PHC) in South Sulawesi Province, Indonesia: Samata Primary Health Care in Gowa District, Wara Primary Health Care in Palopo City, Bulukunyi Primary Health Care in Takalar District, and Bontomate’ne Primary Health Care in Jeneponto District. All children in this study were the age of 18-35 months and breastfed or being breastfed during the data collection period (December 2016 to January 2017 in Gowa District and Palopo City; and November to December 2019 in Takalar and Jeneponto Districts). Children diagnosed with delayed development were excluded from the study. Written informed consent was obtained from the mothers to participate in the study (Figure 1). A total of 286 children were included: 76 from Samata PHC Gowa District; 94 from Wara PHC Palopo City; 70 from Bulukunyi PHC Takalar District; and 46 from Bontomate’ne PHC Jeneponto District.

Data on BF duration were obtained from a questionnaire distributed among the mothers. The BF duration was categorized into three parts: ≤6 months, 7–18 months, and >18 months. A separate questionnaire was used to obtain demographic data, including mother and children status. Mothers’ information including age, oc-

cupation, family income, family language, health condition during BF (diseases or illnesses [yes/no]), pregnancy information (frequency, number of antenatal care visits [sufficient if ≥3 visits or insufficient if <3 visits during pregnancy] and method of pregnancy delivery),^{10,11} as well as information regarding whether family support was provided during BF,^{12,13} was obtained.

Information on their breastmilk production was also gathered (yes/no).¹⁴ Formula promotion was determined based on mothers’ awareness of infant formula, based on the information from health care professionals. Maternal knowledge of BF was grouped into sufficient (>5 correct answers) and insufficient knowledge (≤5 correct answers).¹² Additionally, mothers’ BF practice was categorized into good (performing 3 or 4 BF practice components), average (performing 2 BF practice components), and poor (performing only 1 BF practice component).¹⁵ Family’s smoking habits were classified into yes or no, whether a family member is a smoker. Additional information on children, such as their birth weight, health status, birth order among the siblings, and the total number of children in the family, were obtained from the questionnaire. Further, children were classified based on whether they fell ill during the BF period. All questionnaires were filled out with the assistance of a skilled enumerator.

Maternal weight and height were measured using the Omron digital weight scale and GEA medical microtoise stature meter, respectively. Maternal body mass index (BMI) was calculated using the BMI formula (BMI =

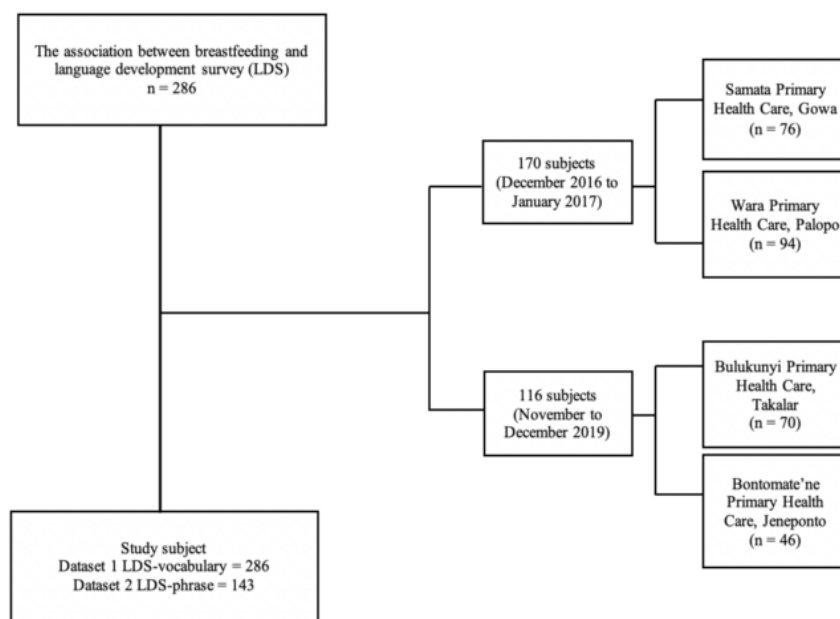


Figure 1. Participation Recruitment Flow

kg/m²), where kg represents maternal weight in kilograms and m² represents their height in meters squared.¹⁶ Children's nutritional status was classified into severely underweight (< -3SD), underweight (-3SD to < -2SD), normal (-2SD to 1SD), and at risk of being overweight (> 1SD) using the weight-for-age Z-Score Table based on the Regulations of the Minister of Health of the Republic of Indonesia Number 2 of 2020 concerning Child Anthropometry Standards.¹⁷

To identify children's language abilities, the LDS was employed and adapted. The survey was developed by Rescorla in 1989 as an alternative to previously designed language assessment tools, which were inefficient and inadequate to measure children's language ability.⁸ The survey, designed as a screening tool and had to be completed by parents (especially mothers), can identify children's language (vocabulary and phrase productions) and predict a potential language delay in children aged 18–35 months. The validation studies of LDS were conducted and showed a high correlation with three other similar assessment tools.¹⁸

The LDS-vocabulary contains 310 vocabulary words arranged by semantic category. Parents' answers in the survey represent words or vocabulary uttered by their children. The total number of words or vocabulary was summarized by a skilled enumerator to calculate the LDS-vocabulary score. Parents with children aged 24 months or older were asked to list the five longest and best phrases their children could produce. The average number of words for the five phrases was calculated to assess their LDS-phrase score. Interpretations of LDS scores—vocabularies and phrases—were conducted by grouping children according to age and sex. Children's LDS-vocabulary was scored on the basis of their age groups (e.g., 18–23 months, 24–29 months, or 30–35 months). Similarly, children's LDS-phrase was scored on the basis of their age groups (e.g., 24–29 months and 30–35 months). Furthermore, a mean score technique was applied to assess children's LDS-phrase production.²

The data were presented descriptively as mean ± standard deviation (SD) for normally distributed data, median (interquartile range/IQR) for non-normally distributed data. While, data with frequency was presented as percentage of collected data. The prevalence rate among different BF groups was compared and calculated using Pearson's Chi-square test. The association between BF and LDS score (vocabulary and phrase) was examined using logistic regression analysis (univariate and multivariate). First, Model 1 (crude model) was conducted to identify whether an unadjusted association exists between the determinant and the outcome. Then, several potential confounder factors (maternal age) were consecutively included in Model 2; Model 3 was augmented (Model 2 + occupation), and Model 4 was further

augmented (Model 3 + family income + the number of children). Model 4 was considered the fully adjusted model. The changes in the odds ratio were evaluated using the adjustments from Models 1 to 4, and the results were considered significant at p-value < 0.05. All statistical analyses were conducted using the IBM Statistical Package for Social Sciences (IBM SPSS Statistics for Windows; IBM Corp., Armonk, New York, USA) Version 26.

Results

Among the 286 children in this study, the majority (55.2%) were breastfed for >18 months. The number of children who were breastfed for 7–18 months and six months were 78 (27%) and 50 (17.5%), respectively. The mean age of the children was 26.51±5.1 months. Most mothers were housewives with a low to moderate family income (less than one million and up to three million rupiahs per month) and had normal BMI (24.88±12.65) with a mean age of 30±6.1 years. The overall prevalence of underweight and severely underweight children was 18.8% and 6.5%, respectively. The proportion of severely underweight children was the highest in those with a BF duration of 7–18 months (13%), whereas overweight was 6.1% in children with a BF duration of six months. In line with family support during BF, most mothers (57.7%) confirmed receiving support, and their BF practices were predominantly classified as good (45.8%) (Table 1).

Moreover, mothers receiving less infant formula promotion and having adequate milk production appeared to have the longest BF duration (>18 months). During the BF period, the health status of the mothers was similar across the BF duration groups and the children's health status. Apparently, having only one child in the family influenced the BF duration. In a two-children family, the highest prevalence of BF duration was 7–18 months, whereas, in a single-child family, the BF duration was longer. However, the birth order of children did not differ among the BF duration groups (Table 1).

Association of Breastfeeding Duration and Children's Language Development (Vocabulary Score and Phrase Score)

The LDS-vocabulary scores of the 286 children revealed that 91 children (31.8%) experienced language delays. Children who were breastfed for 7–18 months had the highest percentage (33.3%) of delayed vocabulary development, according to their age. Data analysis on the association between BF-group and LDS-vocabulary score revealed a similar prevalence in normal vs. delayed LDS-vocabulary scores across different BF duration groups (p-value = 0.937) (Table 2). The LDS-phrase score was assessed in the subset of children (24–35

months). The prevalence of delayed LDS-phrase score was 35.7%, consistent with LDS-vocabulary; the highest delayed LDS-phrase was observed in the BF group of 7–18 months (39.5%). The association between BF duration and the event of delayed LDS-phrase score was similar within BF groups (p-value = 0.849) (Table 2).

Association of Breastfeeding Duration and Language Development (Vocabulary Scores)

The association of BF duration and delayed vocabulary development was analyzed using logistic regression with adjustments for the maternal age, occupation, family income, and the number of children. The result showed

Table 1. Subject Characteristics

Variable	Category	≤6 months (n = 50)	7–18 months (n = 78)	>18 months (n = 158)	p-value
Maternal and family characteristics					
Age (median, IQR)		31 (19–48)	30 (17–50)	30 (18–75)	0.23 ^a
BMI (median, IQR)		22.7 (15–35)	23.3 (15–160)	23.15 (9.5–157.5)	0.76 ^a
Maternal occupation (n, %)	Civil servant	3 (10.7)	3 (7.3)	6 (6.3)	0.04 ^b
	Self-employed (business)	0	2 (4.9)	6 (4.7)	
	Housewife	24 (85.7)	35 (85.4)	87 (68.5)	
	Laundress, laborer, domestic assistant	1 (3.6)	1 (2.4)	26 (20.5)	
Family income (n, %)	<1 million (IDR)	16 (32)	30 (38.5)	63 (40.1)	0.28 ^b
	1–3 million (IDR)	21 (42)	34 (43.6)	74 (47.1)	
	>3 million (IDR)	13 (26)	14 (17.9)	20 (12.7)	
Maternal health status (n, %)	Healthy	15 (53.6)	16 (39)	48 (47.1)	0.47 ^b
	Sick	13 (46.4)	25 (61)	54 (52.9)	
Pregnancy record					
Number of antenatal care visits (n, %)	Sufficient	24 (88.9)	35 (89.7)	80 (80.8)	0.33 ^b
	Insufficient	3 (11.1)	4 (10.3)	19 (19.2)	
Number of pregnancies (n, %)	1	4 (14.3)	5 (12.2)	29 (28.4)	0.22 ^b
	2	13 (46.4)	14 (34.1)	38 (37.8)	
	3	5 (17.9)	12 (29.3)	20 (19.6)	
	>3	6 (21.4)	10 (24.4)	15 (14.7)	
Method of delivery (n, %)	Vaginal birth	24 (85.7)	33 (80.5)	91 (89.2)	0.38 ^b
	C-section	4 (14.3)	8 (19.5)	11 (10.8)	
Children’s characteristics					
Sex (n, %)	Male	28 (56)	39 (50)	74 (46.8)	0.52 ^b
	Female	22(44)	39(50)	84(53.2)	
Birth weight in grams (median, IQR)		3,000 (1,900–3,800)	3,000 (2,500–4,500)	3,000 (1,450–4,200)	0.54 ^a
z-weight-age (n, %)	Normal	40 (81.6)	50 (64.9)	108 (70.5)	0.07 ^b
	Underweight	5 (10.2)	17 (22.1)	56 (19.9)	
	Severely underweight	1 (2)	10 (13)	25 (8.2)	
	Overweight	3 (6.1)	0	4 (1.4)	
Number of siblings (n, %)	1	14 (28)	17 (21.8)	53(33.5)	0.45 ^b
	2	20 (40)	32 (41)	54(34.2)	
	≥3	16 (32)	29 (37.2)	51(32.3)	
Children’s birth order (n, %)	1	19 (38)	24 (30.8)	54 (34.3)	0.94 ^b
	2	15 (30)	28(35.9)	52 (32.9)	
	≥3	16 (32)	26 (33.3)	52 (32.9)	
Children’s health status (n, %)	Healthy	9 (32.1)	11 (26.8)	23 (22.8)	0.58 ^b
	Sick	19 (67.9)	30 (73.2)	78 (77.2)	
Breastfeeding record					
Perceived breastmilk production (n, %)	Sufficient	24 (85.7)	39 (95.1)	96 (94.1)	0.25 ^b
	Insufficient	4 (14.3)	2 (4.9)	6 (6.59)	
Maternal knowledge of BF (n, %)	Sufficient	27 (96.4)	40 (97.6)	98 (97)	0.96 ^b
	Insufficient	1 (3.6)	1 (2.4)	3 (3)	
Exposure to infant formula promotion (n, %)	No	15 (53.6)	27 (65.9)	74 (72.5)	0.16 ^b
	Yes	13 (46.4)	14 (34.1)	28 (27.5)	
Maternal practice of BF (n, %)	Good	22 (48.9)	28 (35.9)	81 (51.3)	0.15 ^b
	Average	10 (22.2)	24 (30.8)	44 (27.8)	
	Poor	13 (28.9)	26 (33.3)	33 (20.9)	
Family support (n, %)	Yes	26 (92.9)	38 (92.7)	101 (99)	0.09 ^b
	No	2 (7.1)	3 (7.3)	1 (1)	
Maternal and family’s language (n, %)	Native language	30 (60)	37 (47.4)	73 (47.4)	0.51 ^b
	Local language	9 (18)	20 (25.6)	44 (28.6)	
	Mix language	11 (22)	21 (26.9)	37 (24.0)	
Smoking status of family members (n, %)	Smoker	7 (25)	9 (22.5)	24 (23.8)	0.97 ^b
	Non-smoker	21(75)	31(77.5)	77(76.5)	

Notes: ^aKruskal Wallis for numerical data, ^bPearson’s Chi-square for categorical data
 IQR = Interquartile Range, IDR = Indonesian Rupiah, z-weight-age = z Score Weight per Age, BF = Breastfeeding.

Table 2. Language Development Survey Scores by Breastfeeding Duration Groups

Variable	Category	Total	≤6 months	7–18 months	>18 months	p-value
LDS-vocabulary (n = 286)	Normal	195 (68.2)	34 (68)	52 (66.7)	109 (69.0)	0.937
	Delayed	91 (31.8)	16 (32)	26 (33.3)	49 (31.0)	
LDS-phrase ^{b,c} (n = 143)	Normal	92 (64.3)	19 (65.5)	23 (60.5)	50 (65.8)	0.849
	Delayed	51 (35.7)	10 (34.5)	15 (39.5)	26 (34.2)	

Notes: LDS = Language Development Survey.

Interpretation of LDS-vocabulary and LDS-phrase scores were adjusted on the basis of children's sex and age. Percentages are mentioned within parentheses.

^aLDS-vocabulary categories were based on the analysis of all subjects (n = 286), ^bLDS-phrase categories were based on the analysis of children aged 24–35 months (n = 143), ^cMissing data for the total phrase was 30%.

Table 3. Association of Breastfeeding Duration and Language Development (Vocabulary Scores)

Model (n = 286)	Category	Odds Ratio (95% CI)	p-value
Model 1 (Crude OR)	≤6 months	Reference	
	7–18 months	1.06 (0.50–2.27)	0.88
	>18 months	0.95 (0.48–1.89)	0.89
Model 2 (Model 1 + maternal age)	≤6 months	Reference	
	7–18 months	1.01 (0.47–2.17)	0.98
	>18 months	0.89 (0.45–1.78)	0.74
Model 3 (Model 2 + maternal occupation)	≤6 months	Reference	
	7–18 months	1.00 (0.37–2.76)	0.99
	>18 months	0.68 (0.28–1.65)	0.39
Model 4 (Model 3 + family income + number of children)	≤6 months	Reference	
	7–18 months	0.86 (0.30–2.47)	0.79
	>18 months	0.57 (0.23–1.42)	0.23

Note: CI = Confidence Interval

that the risk of delayed LDS-vocabulary score was lower in the BF duration group of >18 months as compared to the BF duration group of ≤6 months, although it was not statistically significant (OR [95% CI] = 0.57 [0.23–1.42]; p-value = 0.23) (Table 3, Model 4). Model 4 was the fully adjusted model for the association between BF duration and delayed vocabulary development (measured by the LDS-vocabulary score). Although insignificant, the analysis showed that a longer BF duration (>18 months) could effectively reduce the risk of delayed vocabulary development.

Association of Breastfeeding Duration and Language Development (Phrase Scores)

In line with the findings on LDS-vocabulary, this study also calculated the association between BF duration and delayed LDS-phrase scores in children aged 24–35 months. Similarly, children with a longer BF duration had a lower risk of delayed phrase development than the reference group (BF ≤6 months). In the fully-adjusted model, the risk of delayed phrase development in children with a BF duration of >18 months was less than half the odds of those with a BF duration of ≤6 months (OR [95% CI] = 0.46 [0.14–1.67]; p-value = 0.25) (Table 4, Model 4). A huge decline in OR was observed when ma-

ternal employment status variable was entered into the model. Data analysis showed a clear trend toward lower odds ratios, as shown in Model 1 to Model 4, suggesting that longer BF duration might prevent delayed phrase development.

Following the missing data in this study, a sensitivity analysis was performed to calculate the estimated coefficients of the complete data (n = 171), and a similar result was found with the total sample (n = 286). The results of the fully adjusted model of LDS-vocabulary unveiled that the risk of BF duration >18 months was less than the ≤6 months one (OR [95% CI] = 0.61 [0.24–1.57]; p-value = 0.78). Along with this result, the risk of the LDS-phrase score of BF duration of >18 months (OR [95% CI] = 0.28 [0.62–1.23], p-value = 0.09) were revealed to be less than the ≤6 months.

Discussion

Although this study found no association between BF duration and LDS scores, the adjustments for confounders revealed that a longer BF duration might prevent delayed language development. Maternal age, working status, family income, and children's number of siblings might affect the relationship between BF duration and language development. The above variables were po-

Table 4. Association of Breastfeeding Duration and Language Development (Phrase Score)

Model (n = 143)	Category	Odds Ratio (95% CI)	p-value
Model 1 (Crude OR)	≤6months	Reference	
	7-18 months	1.24 (0.45-3.38)	0.68
	>18 months	0.99 (0.40-2.43)	0.98
Model 2 (Model 1 + maternal age)	≤6 months	Reference	
	7-18 months	1.17 (0.42-3.25)	0.76
	>18 months	0.95 (0.38-2.36)	0.92
Model 3 (Model 2 + maternal occupation)	≤6 months	Reference	
	7-18 months	0.71 (0.17-2.91)	0.64
	>18 months	0.55 (0.17-1.79)	0.32
Model 4 (Model 3 + family income + number of children)	≤6 months	Reference	
	7-18 months	0.80 (0.18-3.55)	0.78
	>18 months	0.46 (0.14-1.67)	0.25

Note: CI = Confidence Interval

tential confounders that must be considered to reveal the relation between BF duration and language development, including vocabulary improvement.¹⁹

Children’s language development was determined by two main factors: internal and external factors.²⁰ The internal factors were related to children’s genetics, health status, and nutritional status. In contrast, the external factors were linked to family environment, parents’ level of education, children’s school environment, and parenting patterns. Although some aspects of the internal and external factors had been included in this study, family environment and parenting patterns factors that specifically describe mother-child closeness were not studied.

Studies on BF duration yielded mixed results regarding the best BF duration influencing cognitive and language ability. These studies vary widely, ranging from less than six months, exclusive BF (6 months), more than six months, 12 months, to more than 12 months. Interestingly, a BF duration of 3-6 months was sufficient to support early and late childhood language development.^{1,21-23} Moreover, mothers who breastfed for six months promoted continuous improvement in their children’s intelligence (including vocabulary development) until they reached 15 years old.²⁴ Conversely, a study in Balochistan about the association between BF and cognitive and language development stated a need to lengthen BF duration to more than 12 months to enhance cognitive and language development significantly.²⁵

Similar to a study in Balochistan, although this study’s data were not statistically significant, a BF duration of >18 months appeared to prevent language development delay in children. While, a study examining children’s cognitive and noncognitive development found no association once the children reached the age of five.²⁶ The results also highlighted mothers’ educational background as a significant factor in children’s cognitive development.^{26,27}

Two mechanisms were attributed to the correlation

between BF duration and improvement of cognitive ability, which included children’s language development. First, human milk contains a specific fatty acid known as Polyunsaturated Fatty Acid (PUFA), consisting of Docosahexaenoic acid (DHA) and Arachidonic Acid (ARA) that aids in the myelination of brain neurons, thereby supporting cognitive development.^{28,29} Second, BF fosters emotional intimacy between mother and child, stimulating positive emotions and reducing antisocial and aggressive behaviors associated with children’s cognitive development.²⁸

The LDS score is not commonly administered to assess language development for medical and health studies. For example, several studies preferred other tools, including Receptive and Expressive Vocabulary Tests (REVT), DDST, Early Language Milestones (ELM), and the Receptive-Expressive Emergent Language Scale (REEL), to assess children’s language development.^{26,30} However, these language screening tools have been broadly used in pediatric settings, and it is important to note that “they are not without limitations.” Some of the questions in these assessment tools may be overly vague and leave out critical information regarding children’s language development. For example, in ELM, which seeks children’s word production, the tools only ask parents or guardians whether their children can produce a minimum of 50 words without requiring them to provide examples of such words or vocabulary.⁶ The LDS has demonstrated a much more advanced technique in identifying, capturing, and analyzing information regarding children’s language development compared to other assessment tools.³¹

However, given that information is solely acquired from parents or guardians (rather than children themselves), observations of children’s daily interactions are crucial. Parents or guardians can provide the LDS with a wealth of information regarding their children’s language development if they have made accurate and thorough

observations. Hence less input from the parents or guardians may leave out sensitive information that can be useful in predicting whether children experience mild language delays. For example, when this study requested information on their children's phrase production, roughly 30% of the participants failed to provide detailed information regarding their children's phrase ability. Consequently, although their children performed well in vocabulary production, the inadequate information from phrase productions might indicate other implications.

Strength and Limitation

This study emphasized language development by introducing the LDS as an assessment tool to reveal comprehensive information on the language development of children aged 18–35 months. Particularly, LDS can identify specific language delays, that is, words and phrases, that can guide the effectiveness of children's language therapy. Furthermore, LDS is considered the best tool for measuring children's language because of its efficacy in the assessment and data analysis process. It can be personally conducted and analyzed by parents, guardians, or others interested in children's language development.

Nevertheless, this study had some limitations, such as the limited number of subjects and insufficient data on how the length and frequency of each BF duration influence the effect of BF duration on language development. Moreover, the study did not obtain data regarding mothers' direct versus indirect BF practices, which may affect children's language development. Lastly, this study employed a cross-sectional data approach, which only described a single shoot on both variables with no further follow-up data.

Conclusion

This study lends support to the role of BF duration in the language development of children aged 18–35 months, specifically by employing the LDS tool. It also finds no significant association between BF duration and LDS score. Nevertheless, a trend towards longer BF duration seems able to prevent delayed language development problems. This study encourages further exploration on children's language development and the use of LDS as a specific assessment tool to evaluate it.

Abbreviations

BF: Breastfeeding; LDS: Language Development Survey; AOR: Adjusted Odds Ratio; PDQ: Pre-screening Developmental Questionnaire; DDST: Denver Developmental Screening Test; PHC: Primary Health Care; BMI: Body Mass Index; SD: Standard Deviation; IQR: Interquartile Range; IDR: Indonesian Rupiah; OR: Odds Ratio; PUFA: Polyunsaturated Fatty Acid; DHA: Docosahexaenoic Acid; ARA: Arachidonic Acid; REVT: Receptive and Expressive Vocabulary Tests; ELM: Early Language Milestones; REEL: Receptive-Expressive Emer-

gent Language Scale.

Ethics Approval and Consent to Participate

Ethical approval for the study was obtained from the ethical committees of the Faculty of Medicine, Universitas Hasanuddin, Indonesia (ref: no.176/H4.8.35.31/PP36_KOMETIK/2017) for study sites in Gowa District and Palopo City and the ethical committees of the Faculty of Medicine and Health, Universitas Islam Negeri Alauddin, Indonesia (ref: no. E.010/KEPK/FKIK/XII/2019) for study sites in Jenepono and Takalar Districts and all participants provided written informed consent.

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The generated dataset is available to share from the corresponding author upon a reasonable request.

Authors' Contribution

AF designed the study, collected samples, conducted quantitative data analyses, and drafted the manuscript. AMR collected samples, interpreted the LDS score, and drafted the manuscript. SJ gave feedback and revised the manuscript. AIS analyzed the data and provided input, and revised the manuscript. The author(s) read and approved the final manuscript.

Acknowledgment

This study abstract was presented at the 15th Symposium on Nutri Indonesia in conjunction with the 7th International Nutrition Symposium 2020.³² This article has been published in Research Square as preprint with DOI: <https://doi.org/10.21203/rs.3.rs-580559/v1> consisted only a preliminary report that has not undergone peer review. It should not be considered conclusive, used to inform clinical practices, or referenced by the media as validated information. Dr. Faradilah is supported by grant 585898-EPP-1-2017-1-NL-EPPKA2-CBHE-JP from the HEALTH-I project. The HEALTH-I project is epidemiology blended learning and capacity building program in Indonesia, funded by the European Commission under the Erasmus+ Capacity Building in Higher Education grant program. The sponsor had no role in the design, collection, analysis, manuscript preparation, or the decision to submit for publication.

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